The FOUNDRY

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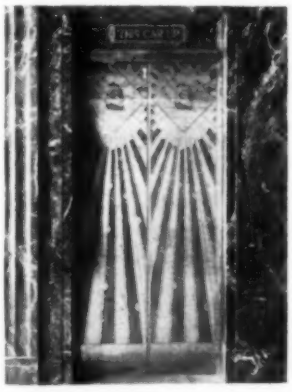
Castings Make Elevator Operation Safe

MANHATTAN'S skyline or the picture presented by the lakefront in Chicago would not be possible if it were not for the remarkable progress that has been made in the development of the passenger elevator.



Castings Have Made Possible Much of the Progress in Elevators

The modern vertical lift probably originated with the platform hoist made by Henry Waterman in New York in 1850. In 1852, Elisha Graves Otis began the manufacture of elevators and just two years later he developed the first device to prevent the car platform from falling in case the rope should break. While various types have been used, the electrically driven lift, which was first used successfully in 1889, is installed in the majority of the modern buildings. Recent improvements in elevators include the car which levels at the floor automatically, regardless of the operator; the car which is controlled automatically by the operator pressing buttons designating the floors at which the car is to stop; numerous safety devices, and elaborate signal systems. It is interesting to note that castings are used extensively in the construction of the lifting mechanism, the cars and other equipment such as buttons, indicators, etc.

Find Where Castings Can Be Sold.

CONTENTS

Feature Articles

	Page
Castings Play Important Part in Lighting Fixtures—By Norman F. Hindle	18
Business Planning Provides Profit Stabilization	22
Material Handling Show Combines with A. F. A. Exhibit	25
Prevent Losses with Proper Gates and Risers—By Pat Dwyer	26
Hunt Defects with Large X-Ray	29
Gray Iron Institute Studies Test Bars	30
What Oxidized Scrap Can Do To Iron—By Garnet Phillips	33
Contraction Allowance Varies with Conditions—By R. A. Bull	35
Bill Learns of Facing Molds Abroad—By Pat Dwyer	37
Even the Customer Prefers To Buy by the Piece—By E. W. Johnston	39
Show Profit by Pushing Sales and Advertising Efforts	40

Regular Departments

Reader's Comment	22	The Shakeout	42
Questions and Answers on Foundry Practice	31	Comings and Goings of Foundrymen	43
Problems in Nonferrous Founding—By Charles Vickers	32	Obituary	45
		What Others Are Thinking	46
The Foundry Family Photograph Album	41	What the Foundries Are Doing	49
		New Trade Publications	49

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Castings Play Important Lighting Fixtures

MEASURED in terms of service to the human race, the development of the incandescent light by Thomas A. Edison in 1879 ranks of first importance. Prior to that time, sources of light consisted mainly of the candle and the kerosene lamp; exceedingly poor when considered by the standards of today.

It is unnecessary to enumerate the many advantages that have accrued through that invention. Of course, it has acted as a stimulus for the scientific study of light and lighting conditions. Typical of the American viewpoint, not to be satisfied with a commodity if improvements are possible, developments have been made in the electric light until it now has reached a high degree of efficiency.

Fig. 1—Two Plaster Matches Used for Lamp Shade Castings. The Pattern for the One on the Left Is Shown at the Top

Relative efficiency of the various methods of lighting depends, to a large extent, on the fixtures used in the installation. Certain standard types have been designed for industrial installations and the type installed generally depends upon the class of work possible in a particular plant. In the lighting installations of buildings and homes fixtures follow closely the style and design of the building. Although each style requires a different type of design, each installation must not only be one of beauty, but must give the proper amount of light.

For that reason, companies specializing in both commercial lines and individual fixture installations must maintain a highly specialized designing department in which the men not only must be thoroughly familiar with the various styles of architecture but also must be on the lookout constantly for the ever changing trend in building design. The Kayline Co., 600 Huron road, Cleveland, maintains such a staff which designs not only the many individual installations which the company makes, but also its commercial lines of fixtures.

The company operates a complete plant for the manufacture of fixtures from the evolution of the original design to the shipment of the completed articles. Departments are operated for designing, modeling, casting, spinning, fitting, polishing, buffing, plating and assembling. The plant occupies 6 floors of the building in which it is located. The layout is such that materials are routed from the top floor to the bottom, where the finished article is shipped to the ultimate consumer.

Evolution of a series of fixtures is an interesting and at times a rather complicated process. When a large building is to be erected and a certain number of fixtures of individual design are required, a designer interviews the architect to get the general layout and the decorative idea that is to be carried out in the building before the bid can be submitted. A set of blueprints are secured and from those a list of all the outlets is made. The designer then is ready to begin work.

Sketches are made of the fixtures to be used in the various locations, taking into consideration all details. The design must have general appeal and it must follow the decorative scheme of the building, the style of architecture, and be planned to illuminate each location fully. Following the outline sketch of the fixture, the drawing is placed face down on another sheet of

Part In

By Norman F. Hindle

Fig. 3—Several Castings Often Are Molded in the Same Flask

paper, on which the finished drawing is to be made, and rubbed down. This rubbing down operation consists of placing a piece of tracing cloth over the paper with the design, and rubbing the cloth with a blunt tool. That transfers the design to the blank paper but in the reverse position. However, that does not present any difficulty since the various pieces must be symmetrical in design.

Following this operation, the transferred sketches are outlined and colored to blend with the color scheme on which it will be used. All drawing and sketching is done by the free-hand method and the various sketches made must cover fully all locations in the building. For some jobs, as high as 60 individual drawings must be made to include completely the various outlets.

Requires Time and Study

All of this work, which requires a large amount of time, labor and study and which involves not only individuality of design but also the method of suspension, number of lights, desired brightness, etc., is done preliminary to submission of the drawings for approval of the client. After submission and providing the job is secured, the manufacture of fixtures begins.

Free-hand working drawings of full-sized dimensions are made from the submitted sketches. These give all the details of the job. Blueprints then are made from the approved full-sized, working drawings and are distributed to the various departments where the work is to be performed. In addition to the individual jobs made by the Kayline company, it also makes a varied line of commercial fixtures. This type of work requires a great deal of time and thought since a new line, or revisions in the old, are necessary approximately every 6 months. The company also is recognized as especially capable in the design and manufacture of ecclesiastical and denominational work. Thirty-eight years of experience in the fixture business has made the company entirely conversant with the subject. The more than 15,000 designs in the files of the firm also give an idea of the variety available.

Castings play an important part in the manufacture of fixtures. They are being used in greater quantities at this time due to the trend toward the use of colored glass in practically all fixtures. The evolution of patterns required for the manufacture of castings is interesting, due to the fact that a large amount of the business is for individual installations which will demand but few and sometimes only one casting from a pattern. Such a condition means departure from the regular procedure of pattern manufacture. However, the small number of castings required from one design is not the only variation, since intricacy of designs is important.

Various types of patterns are used, depending, to a large extent, on the ease of working the design in the material, the type of pattern, used also depends to some extent on the

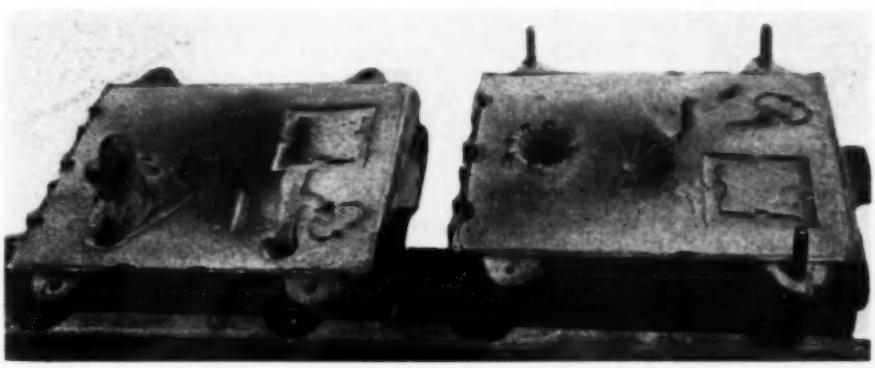


Fig. 2—Skin-dried Molds Ready To Be Poured. The Casting in the Upper Right Hand Corner of the Drag Is Gated both in the Cope and Drag

number of castings required. The material selected for use is the one which will produce the best pattern, wood, plaster, wax, brass and bronze being utilized for that purpose. The production of such patterns is interesting because of the large amount and delicacy of work involved.

Following the blueprinting of the previously mentioned working drawings, one is sent to the modeling department. Here work begins on the actual construction of the pattern. The modeler is a man skilled in the art of *chasing* which comes from the French, *chasse*. The art was developed in France and spread to many of the European countries and in some is known still under the French name. A dictionary definition of the word chase describes it as follows: "To ornament a metal surface by embossing, engraving or the like."

Use Variety of Methods

The modeler first studies the blueprint and determines how to attack the problem. For ordinary work where the patterns are made in wood or metal, the usual practices of patternmaking are followed. Where the pattern has an irregular parting line, it often is necessary to make it of wax or plaster.

The first step in the construction of a wax pattern is to cast a piece of plaster of paris of the required size on which the irregular parting line is cut. The plaster, impregnated with a blue pigment, is poured into a wooden frame. The modeler then tools the parting line to the correct contour, as may be noted in Fig. 4, and coats the parting face with shellac. A second frame is built which fits the original piece on three sides, but is longer on the end on which the parting has been cut. The opening which remains in the frame is filled with white plaster of paris. This method of construction leaves a distinct line of demarkation along the parting line of the pattern between the blue and the white sections.

The desired casting design then is carved in the white plaster, with all details of casting design, draft and thickness of casting considered. A white plaster section with the pattern carved on it is shown at the left in Fig. 4. While it is possible to carve the pattern from a plaster block without the preliminary cutting of the parting line, it has been found that the methods first described require considerable less time. After the pattern has been carved, that section of the plaster mold is known as the *positive*.

Make Reverse Plaster Cast

A *negative* is made after the positive section has been completed. The positive extends above the parting line of the pattern, while the *negative* is the opening in a piece of plaster into which the pattern fits exactly, as shown at the right in Fig. 4. To produce the negative the surface of the positive is coated with oil and the section is placed in a frame sufficiently large to allow the plaster to flow against the surface of the positive and of sufficient depth to leave an impression in the solidified plaster. When the plaster has solidified, the positive and the negative are pried apart. The positive section of the pattern now has served its purpose and is not used again.

The indentation in the negative then is filled with modeler's clay to give the thickness of the required wax pattern. After the face has been coated with oil to keep the two sections of plaster from sticking together, another section of plaster of paris is cast against the negative with the clay in position. After the new plaster has hardened, the two sections are pried apart and the clay removed from the negative. That leaves two blocks fitted closely together with a space between the indentation and the backing block equal to the desired thickness of metal in the casting. When that cavity is filled with wax, a wax pattern is the result. Before the wax can enter the mold, a method of ingress must be made. That is cut in the plaster mold at the parting line as shown in Fig. 6. Before the wax is poured, the mold is dipped in water to keep the wax from sticking to the plaster and it is dipped again after the wax is poured to aid in solidification. When the wax has hardened, the mold is opened and the wax pattern removed.

The previously described procedure is applied both to patterns which have designs on one face only and to those which have designs on both faces. In patterns where both faces are designed, as that shown in Fig. 5, a model is made for half the pattern and since both sides of the piece must be symmetrical, two wax half patterns are made and pasted together with glue, shellac or a similar substance. That method eliminates the necessity of casting and carving two plaster patterns, one for the front and one for the rear. If only a single casting is required, the wax pattern is sent to the foundry and the casting made from that. However, if several castings of that type are required for an installation, often a metal pattern is made from the wax.

In the latter case, the wax pattern and the backing section of the plaster mold are sent to the foundry and are rammed in the mold in the following manner. A dummy cope is rammed and the wax pattern with its backing plaster piece are embedded in the mold. If a wax pattern alone is used, it practically is impossible to secure the correct parting line as wax bends out of shape easily. It is the function of the plaster backing piece to hold the wax pattern to the correct contour.

Molds the Pattern

After the pattern and backing piece have been embedded in the mold, the backing piece is removed and the desired parting cut. The drag section of the mold then is rammed on the dummy cope and the mold is rolled over, the cope lifted and shaken out. The cope section of the flask is placed on the drag and rammed up in the usual manner. After the sprue has been cut, the cope is lifted off, the wax pattern withdrawn from the mold, the gates cut, and the mold

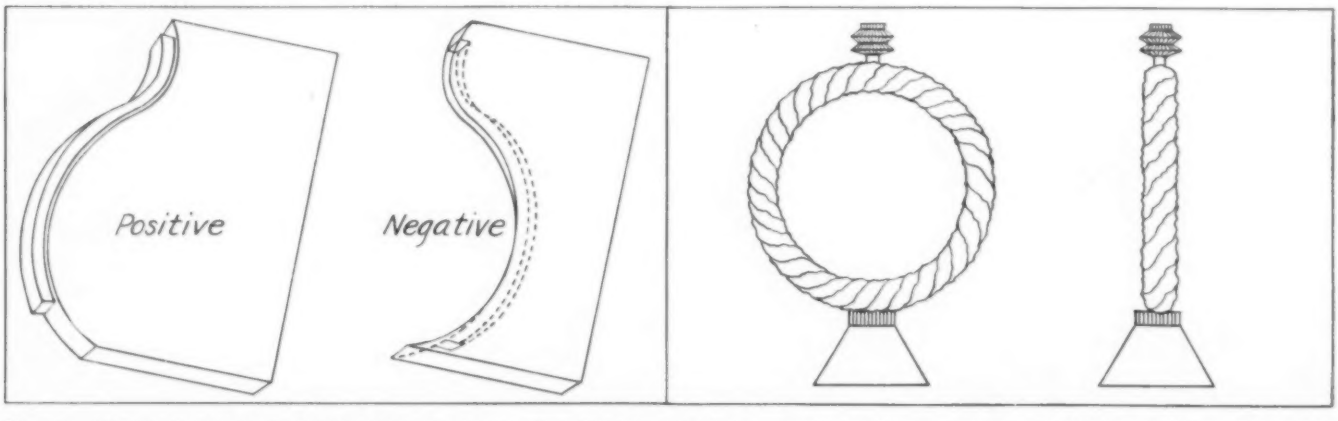


Fig. 4—(Left) Positive and Negative Sections of a Plaster Mold for a Wax Pattern. Fig. 5—(Right) Patterns For This Type of Casting Are Made by Gluing Two Half Sections of the Wax Pattern Together

closed. The mold then is reopened and the sections skin-dried by setting them facing a drying stove. When the mold sections are dry, they are placed on the pouring benches ready for pouring. As the pouring time approaches, the molds are closed and weighted, metal is introduced and allowed to solidify and the casting is shaken out.

This casting is the metal pattern in the rough condition. After the sprue and gates have been removed, the casting is returned to the modeler for the final tooling, to bring out the various intricacies of the design and to be sure that the pattern follows the desired contours. After the metal pattern has been touched up, it is returned to the foundry and is ready for production.

This procedure is followed when only a few castings of a given type are required for an individual installation. In manufacture of standard lines of fixtures aluminum matchplates are used for castings required for these lines since the castings are needed in relatively large quantities.

In molding lighting fixture castings, considerable use is made of plaster and sand matches. As previously stated, only a few castings are required for individual installations from various designs and they generally are small. Hence, several patterns often are molded in one flask. Those generally have irregular parting lines and the time required to mold them, due to the necessity of cutting a parting line on each mold, would be excessive. For that reason, the green sand match or false cope is used. These are made by bedding the various patterns in a dummy cope and cutting parting line, ramming the drag on the cope, rolling over the mold, knocking out the cope and again ramming it but baking it about four times as hard as is customary when metal is to be poured into the mold. The mold is again rolled over and the drag lifted from the cope, leaving the patterns in place in the false cope. This method gives an excellent temporary match.

Plaster Matches Used

General preparations for the construction of a plaster match follow practically the same procedure. A dummy cope is rammed and the pattern bedded in it. The parting line is cut with great care to be sure that the proper line is followed. A frame, the same size as the flask and of proper depth is made, set on the false cope and filled with plaster of paris. Before the plaster is poured in the frame, the pattern is coated with oil so that the plaster will not stick. After the plaster is hardened and the pattern removed, the match is ready for use. Plaster matches are not used for small work but rather on the patterns which have deep and irregular partings on which it would be practically impossible to employ the method with a false cope.

Fig. 2 shows a mold which contains five different castings gated from two sprues. That illustration gives some idea of the size of the castings made in the foundry of the Kayline company. In general the following procedure is used. After the plaster or sand match has been made, the pattern or patterns are placed in position and facing sand,

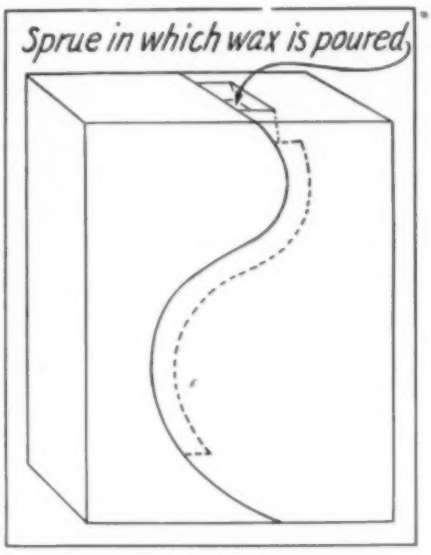


Fig. 6—Method of Gating Plaster Mold for Pouring the Wax Pattern

composed of Windsor Lock sand wetted down to the correct consistency with molasses water, is riddled over the faces of the patterns in the false cope. The drag then is filled with backing sand from the Albany district and rammed well around the flask. The sand in the center of the flask is pressed down well with the fingers and more backing sand thrown on the drag. The final addition is evened off and the molder tromps the sand evenly across the drag. Excess sand is struck off and loose sand thrown over the drag to give a seat to the bottom board which then is set in place.

Prior to the ramming of the drag, the parting lines along the false cope are swabbed with water so that the patterns will lift easily. After the drag has been rammed, the false cope and drag are rolled over and the cope lifted. When the false cope is lifted from the drag, the patterns remain in the drag section of the mold. Parting compound is shaken over the face of the drag and the cope section of the mold is set in place. The cope is rammed in the same manner as the drag and is lifted from the drag and set to one side. Parting lines around the patterns in the drag are swabbed with water and the false cope set on the drag, the mold rolled over and the drag lifted from the false cope which retains the patterns. False cope and patterns are set aside and the mold is finished.

Sprues are cut from the face of the cope and the various castings are gated. At times as many as three different castings with approximately the same thickness are gated from one sprue. Others are gated individually depending on the type of castings being made. In some instances, castings are gated with half the gate in the cope and half in the drag. The method of gating, the number of castings per mold and the number of sprues per mold depend to a large extent on the volume of work called for. After the gates have been cut with a gate cutter, the gates and their entrances to the sprue and to the mold are swabbed with water to eliminate the likelihood of sand getting into the mold and thus being entrapped in the casting.

After the molds are finished, they are faced to a drying furnace to skin dry. When they are dry, the drags are set on benches about 18 inches off the floor with the copes below them on the floor. As the time for pouring approaches, the molds are closed and weighted. The molds are not placed flat on the pouring benches but are in a slanting position generally required in the pouring.

Variety of Metals Used

A wide variety of metals are used in the foundry of the Kayline company. The list includes nickel silver, brass, bronze, aluminum and Richelieu bronze. Two and sometimes three of those metals are poured daily in the foundry and because of the small amount of the metals often required melting difficulties arise. However, these are overcome to some extent in the sequence of pouring.

Few cores are used because wherever possible, patterns are so designed to leave their own green sand cores. However, in lamp shade castings, dry sand cores often are used, especially at present because of the trend of the use of glass sections in the shades rather than cloth. Indentations must be left in the casting for the insertion and support of the glass sections. Cores are used to make the required indentations.

After the gates have been removed from the castings, they are sandblasted and sent to what is termed the making floor. There, the whole fixture is put together in the rough and the various parts checked against the working drawing and sketch. If all the parts conform to the required dimensions, contours, and design, they are dispatched to various departments for buffing, polishing, plating, lacquering, and coloring as the design may require. When work has been completed in these departments, the fixture is assembled, wired and shipped to the client.

Irving M. Day, 306 Chandler building, Washington, has been appointed representative for the Air Preheater Corp., Wellsville, N. Y.

Business Planning Provides Profit Stabilization

A NEW viewpoint has developed in business. The old formula was as follows:

Selling price minus { General and Overhead Expense; Material Cost; Labor Cost }

equals *Profit*, if any

The profit stabilization formula is as follows:

Selling Price minus Profit equals { General and Overhead Expense; Material Cost; Labor Cost }

Profit is considered first and the cloth is cut accordingly. The new philosophy demands that profit be brought about by the direction of all business activities according to a predetermined profit plan. It follows that every activity must be measured to determine its ultimate effect upon profit.

Lose Sight of Goal

To some, this will sound paradoxical. It will be said that profit always has been the goal of business. This is true, unquestionably, but usually a definite series of plays, whereby we are reasonably certain of arriving at the goal have not been worked out, or else, in the haste for results, the goal has been lost sight of altogether.

There has been an all too frequent tendency to regard business in terms of size rather than earning power; to believe that profit would come as a matter of course if volume could only be kept up. Few have made an attempt to so forecast activities that profit would come according to a plan, notwithstanding the fact that planned procedure is deemed essential for business effectiveness. The business executive who survives the times must work according to the new viewpoint. He is not going to use the old formula when thinking about profits.

It takes absolute will power to consider business in its fundamental aspects. We have heard so much about punch and driving power, we often forget that all the pep in the business world represents just that much wasted energy unless directed along right lines. By today's test, an executive not only is a man who can produce profits but one who can produce a maximum amount of profit on a given amount of invested capital. That in substance is the goal of the new viewpoint. Profit stabilization is its practical manifestation.

Economical operation depends upon a correct measuring of consumer demand and the consequent co-ordination with production. Hypothetically, this may be stated as follows: Accurate advance knowledge covering the desires and purchasing power of the consumer.

In practice, this ideal can be approached within reasonable limits but the method followed must differ vastly from the usual practice. A yardstick for measuring economic values must take into consideration the important factor of true consumptive power of the available market. At the same time, it must determine the effectiveness with which business is exploiting these markets, together with the individual businesses' own relative worth as a going concern.

While business may be influenced by dips in the general cycle, failure of individual business more often is caused by some inherent weakness in the judgment of management. Consequently, it is indicated definitely that each business owes to itself the best possible knowledge of conditions surrounding activities in its own field. With facts secured and a course mapped out accordingly, errors in judgment are eliminated automatically.

It is at the point of ultimate consumer demand that changes first occur. Over-production, the failure properly to co-ordinate sales and manufacturing and the attendant losses caused thereby are after all due to an error in judging the needs of the ultimate consumer.

However, in judging consumer demand it is necessary to know not only quantity, but also quality. The element of style must be taken into account. This latter picture becomes increasingly important when it is considered that not only are we in an age of rapid improvement, but that we are dealing with a public whose buying habits are changeable. In short, the subject must be dealt with in the broadest possible manner.

Selling for Greatest Return

Forecasting, therefore, may be set down as the first function of profit stabilization. It serves as a means of direction and an indicator of future trends. The ability to adjust supply to fit demand is after all the only practical basis for profitable operation.

It is not uncommon to find companies attempting to secure business in a territory which can not possibly return sales at a profit. In fact, only a few organizations have made any attempt to establish an economic selling radius. When this is done, a far different picture often is presented. At times, it will be found that the cost of securing a certain portion of the business is greater than ever was imagined, simply because sales expense and sales have been lumped together and come to the management as a bulk figure.

A more detailed analysis might disclose the fact that the company, by reason of selling outside of an economic selling radius, would be far better off with a smaller volume of sales in a territory serviced more logically. This indicates the necessity for reconstructing the accounting procedure so that the cost of securing business

Planning for Profits

ADVANCE planning as the basis for economical control of the individual business and the assurance of profits, constantly is demanding more attention. Numerous factors must be studied, such as the consumer demand or market trend, most economical methods of selling to bring the greatest return, manufacturing costs, invested capital and others. Following the collection of the correct facts on which business progress and profits are dependent, it is necessary to adhere closely to the principles involved.

This outline of a profit stabilization plan has been prepared by the research division of the Sherman Corp., New York.

may be known by territories and, in some cases, by customers.

Another subject due for considerable analysis from the profit viewpoint is brought out when profit by items sold is considered. In one of the large industrial centers, a survey disclosed that retailers were carrying an average of 48 brands per commodity classification, but that the majority of sales in most commodities was concentrated in two or three preferred brands. Investigation from that angle often discloses the possibility of lowering inventories, resulting in the ability to operate with lower invested capital and a proportionate profit increase.

Earn a Proper Return

From the standpoint of management, a given rate of profit on sales is highly desirable. To a lesser degree, thought also is directed to a desired rate of return on capital invested in the business. Unfortunately thinking along the latter lines has not received the prominence it deserves. After all, a given percentage of profit on sales is a secondary consideration; the true object of management should be to earn a proper rate of return on invested capital. Judged from this angle, many supposedly successful companies had better be liquidated, thus permitting their stockholders to take their investment elsewhere.

Pages could be written without half covering many of the more important factors which directly effect invested capital. A summarization may be made by considering that invested capital is proprietary interest in the business. Considering it as an investment, the desire should be to earn a return at least equal to that available on high grade securities. Otherwise, from a comparative standpoint the business should be liquidated so that the investment may be taken elsewhere. Therefore, thought should be directed on how the greatest return can be made.

Alfred P. Sloan, General Motors Corp., has marked convictions on that subject. It is his opinion that management has not done a constructive job unless profits remaining in the business net a return of at least 15 per cent. In short, the returns on invested capital should at least equal that amount. It is quite apparent that not many executives feel fully as strong on this subject. The problem for the individual company is a personal one to be solved by an analysis of local requirements and conditions.

Flexibility is the criterion of successful budgeting and this flexibility can be brought about only as a workable plan is formulated in advance. Primarily, flexibility may be obtained through having the correct profit plan, but there are certain other factors which should be stressed and which, by reason of limitation, have not been covered in detail.

Inventory and contracts for materials should be kept in direct and continuous alignment with current sales. Current liabilities should be kept in proper relationship with working capital. Turnover of inventory should be checked constantly and every effort should be made to order production control so that turnover will be reduced to an absolute minimum. General and overhead expenses, as well as selling expenses, which are not usually considered flexible items should be treated as such and steps should be taken to curtail these expenditures so that they may be held as far as possible in direct relationship with sales volume.

Under the usual circumstances, there is a lack in that field of control. Labor is curtailed more rapidly than that class of expenditures which have their general reflection in salaries. By curtailing expenditures as volume is curtailed, profit is then considered as a constant item to be held in direct proportion to sales unless volume is diminished to almost a minimum figure. Budgeting holds a fixed relationship between all factors which enter into the profit position, but it is necessary that management operate according to this budget if the desired results are to be achieved.

Adequate and Reasonable Profit

Selling prices are made on the basis of a fair degree of operating efficiency and plant capacity and include a profit margin which is considered adequate and reasonable. Operations are conducted accordingly and any violation from the preconceived plan calls for an immediate and drastic action.

Business to be successful must exercise a definite control over all avenues of expenditure, holding outlay in proper relationship to income minus the profit margin. In the foregoing, it has been suggested how that might be done. Space does not permit the development of a practical example covering control features of every outlay of expense.

The profit stabilization plan itself starts with forecasting trends by a market analysis and a study of consumer habits. That forecast is to be set up so that it may be continuous, rather than periodic, since conditions are changing constantly.

Analyze Selling Expense

Next, all avenues of selling expense are made the subject of a careful analysis. Proper selling radius is determined, that the company may not expend its efforts in seeking business in certain territories which cannot return sales at a profit. Such other expenses as calling on customers, carrying a varied line as against a standard line, are also given detailed consideration. Next, the selling organization is asked to work on the basis of a standard program operating against budgets and fixed expense allowances.

Today's gage as to the earning power of a business is based upon the return made on necessary invested capital. Reasoning from that basis, the profit margin on sales is worked out according to volume of sales and the sum to be derived thereby to bring about the required return on the capital investment. Then a pricing policy is adopted which holds in relationship profits and expenditures at various positions of volume. As a result of the pricing policy and predetermined relationships, budgets are worked out which must be adhered to and which can be adhered to if set in a practical manner.

Reader's Comment

EDITOR'S NOTE—***Material Appearing Under This Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.***

Methods Should Agree

TO THE EDITORS:

I have read with great interest the "Short Method for Determining Clay Content" described in the issue of THE FOUNDRY for Nov. 15.

This method is said to be the same as the standard A. F. A. method up to the siphoning point. From there on it differs in that the disintegrated sand is placed in an elutriator and the clay carried off by a rising current of water, the grain remaining behind in the separator, the idea of this modified treatment being intended to shorten and simplify the clay separation.

It is needless to remark that the A. F. A. committee on standard tests, is always glad to receive any suggestions for improving its recommended methods of testing, but at the same time it would like to be convinced that the new method produces the same results as the one already officially recommended.

Since evidence appears to be lacking in this case, I take the liberty of making the following comments:

1. If it is intended that foundrymen are to use the elutriation apparatus for clay determination it should be put on the market in calibrated form, ready for use, and not left for individual operators to do their own calibrating.

2. So far as the description of this

modified method is concerned there is nothing to show that it separates the same size range of particles as the standard siphoning method does, in fact judging from samples Nos. 65, 66 and 67 in the table on page 44, it carries off appreciably more material which is classed as clay, without there being any evidence given to show whether it may not include some pan material.

3. A person unfamiliar with the standard A. F. A. method would naturally conclude that it was much less accurate than the elutriation method, because of the great difference in the duplicate runs, viz., 3.38, 4.31 and 4.70 per cent in Nos. 65, 66 and 67, whereas such is far from the case. Much closer checks than those given can be obtained by the siphoning method. To illustrate, four tests of the same sand were run recently by three different persons, and the greatest variation in a clay content of about 23 per cent, was 0.6 per cent. Five samples of another sand were run by five different persons, and the clay contents determined were 13.07, 13.30, 12.90, 13.16 and 13.22, respectively.

These two cases will, I believe, serve to show that the standard A. F. A. method is not as inaccurate as the published table might lead one to believe.

It is true, of course, that a variation in the composition of tap water might cause differences, but this would probably affect the elutriator just as much.

4. Unless the proposed *short method* is brought into agreement with the standard method, it might lead to serious difference of opinion if, for example, in testing a certain sand the producer used one method, and the consumer the other.

H. RIES,
Technical Director

A. F. A. Committee on Molding Sand Research.

Intelligent Man Is Needed

TO THE EDITORS:

Soaking the charge in the cupola has been an object of discussion for several years. The first definite report is contained in THE FOUNDRY Nov. 15, a description of a series of experiments conducted by W. H. Spencer and M. M. Walling.

Despite the findings in that report I believe that burning about 2/3 of coke bed then adding 1/3 more before the first charge is put in, is the best way to produce good iron. Except in a few foundries the cupola has to stand for at least one hour after it is filled, before the air is applied. This allows plenty of time for the bed to come to a cherry red before it is used. Also the bed is not over burnt and will remain at the same height throughout the heat.

Experimenting with soaking charges in a cupola holding 3 tons in the well it took 31 minutes to fill. First iron was red and gradually increased in temperature until about one ton had been released. Then it was hot.

Charging on live coke bed the well filled in 28 minutes and the iron was hot from the start. A 44-inch bed was used on both occasions, 80 pounds of limestone on bed and 65 pounds on each charge. Had a 54-ton heat and hot iron all the way.

Coke varies a great deal, and only a few cupola men can tell the difference without first trying it and then taking a chance of losing castings. Some coke does not hold the heat as well as others. Where iron is charged on a hot bed and where all drafts on the cupola are closed before charging, the bed becomes dead. Eight to ten charges are melted before it will produce hot iron. When a slight draft is left, the bed burns itself out before air is applied and the cupola man runs into trouble.

Some foundrymen even try a bed as low as 36 inches and expect to decrease melting time without any cupola troubles. Usually the cupola bridges before the heat is half through. The blame is placed on cupola tender or coke, but no person seems to think of raising the bed or changing to a live bed.

A cupola is made to produce a certain amount of iron under normal conditions and at a reasonable cost per ton. Attempt to increase the tonnage per hour is sure to cause some unforeseen trouble, and most likely heavy scrap loss.

In many instances, foundrymen want to decrease their pouring time, but want to use the same melting equipment. During this depression they have been forced to cut their selling price to get work. Tampering with the cupola resulted in heavy losses of casting. They have gone so far as to cut off the limestone on the first four charges. It is the flux that helps to make the first iron hot.

Some say it does not matter where flux is placed on charges. Practical experience shows that when placed on coke it produces the best results. Ladles are easier to clean and they last longer when they don't have to be chipped out with a cupola pick.

When the slag hole is opened the slag should appear and flow freely. A good flow of slag will keep the cupola clean. When slag reaches the bottom of the slag hole it should start to flow and continue to flow more readily as it rises. Dirty and rusty iron takes more flux to make slag flow free.

I always have maintained that an intelligent man is needed on a cupola. A cupola man should have the whole responsibility of melting the iron. He should have a grasp on the theory so as to be able to do things the right way. There can only be one right way to do anything. This includes charging and operating a cupola. Other ways may just get by but they do not give the same results.

PRACTICAL MELTER.

Courtesy Dictates a Reply

TO THE EDITORS:

I shall appreciate your assistance in a little difficulty that partly is due to my own carelessness. I also crave a little of your space in which to protest against a custom that apparently is universal. About two months ago in answering a help wanted advertisement I inadvertently enclosed an original reference instead of the copy. I also enclosed a stamped return envelope and a request to return the reference. Up to the present I have had no reply of any kind. Surely I imposed no undue strain on his courtesy or his activity when I asked the reader of the letter to swing around in his swivel chair and drop a stamped, addressed envelope in the tray at his side. Between one thing and another it is no wonder the gray iron foundry business is fallen on evil days.

A SUBSCRIBER

Buys Long Established Steel Foundry

McConway & Torley Co., Pittsburgh, manufacturer of car couplers and other steel castings, has sold its business and good will to Donald Symington and associates of Baltimore. The business will be continued in Pittsburgh by the new interests.

The McConway & Torley Co. has been identified with the industry since 1868 when the business, one of the oldest in the Pittsburgh district, was founded by the late William McConway. Mr. McConway was a pioneer in the manufacture of malleable iron and later of steel castings and in the development and promotion of the automatic coupler for cars and locomotives. The same mechanical principles used in the design of this coupler were used in designing the present standard coupler of the American Railway association now in universal use in the United States, Canada and Mexico. The McConway & Torley Co. also has manufactured a variety of steel castings for railroad and general industrial use since 1900.

Donald Symington, president of the new McConway & Torley Corp. for many years has been general manager of the various Symington companies. He is chairman of the Locke Insulator Corp., an associate company of the General Electric Co., president of the Baltimore Mail Steamship Co., director of Western Electric Co., International Mercantile Marine Co., Glenn L. Martin Aircraft Co., and Colonial Radio Corp. William McConway, Jr., has been president of the McConway & Torley Co.

Philadelphia Convention Hall Arena, Scene of 1932 A.F.A. Show

Material Handling Show Combines With A. F. A. Exhibit

THE 1932 exhibition of the American Foundrymen's association, to be held in the new municipal convention hall at Philadelphia, May 2 to 6, will combine the annual exhibition of foundry equipment and supplies, one of the largest industrial shows in the country, with the annual National Industrial and Equipment congress sponsored by the American Society of Mechanical Engineers, according to a recent announcement of C. E. Hoyt, executive secretary of the A. F. A.

The Foundry and Industrial exposition, as the show will be known, will be held in conjunction with the thirty-sixth annual convention of the American Foundrymen's association and a National congress sponsored by the materials handling and management divisions of the A. S. M. E. The event will be held under the sole management of the American Foundrymen's association.

In 1931 the National Industrial Congress and Equipment exhibition was held in the public auditorium in Cleveland from April 13 to 18. With material handling equipment dominating the show, approximately 100 companies displayed equipment, materials and control systems designed to provide maximum economy and efficiency in industrial fields. That type of equipment will constitute an important and interesting feature of the Philadelphia A. F. A. show next year.

Improvements Are Made

The combined activities of the A. F. A. convention and the A. S. M. E. industrial congress promises to carry the attendance figures well above the totals of recent years. Manufacturers will have an opportunity of demonstrating to the industry the recent developments which have been made in materials and equipment. Reports indicate that many manufacturers have taken advantage of the business recession to make radical improvements on existing lines and to develop new equipment to do the work of the foundry industry. Results of this work, in most cases, will be shown for the first time at Philadelphia.

Application blanks for space have been sent to manufacturers in the field and an official diagram of the floor space will be forwarded applicants about the middle of January.

In connection with the coming convention and exhibition, the American Foundrymen's association recently has made a study of the audience turnover at recent yearly meetings. The result of such a study may be expressed best in terms of new attendance by firms represented as compared with the total attendance at previous conventions. The exhibit showing a persistently high percentage of turnover offers new prospects for the sale of equipment. It has been found that the turnover rating of previous A. F. A. shows is unusually high.

Of the total firms represented at the 1928 Philadelphia foundry convention, 39.3 per cent have not been represented at any convention since, 21.7 per cent have been represented at only one convention since and 16 per cent have attended two conventions since.

R. E. Kennedy, technical secretary, reports that the technical program for the Philadelphia meeting rapidly is taking form and that preliminary announcements of papers and sessions will be ready in the near future. Shop operation courses again will be one of the important features of the convention week, with sessions probably covering sand, gray iron, steel, malleable and nonferrous problems. Special sessions will be held by the materials handling and management divisions of the American Society of Mechanical Engineers.

Prevent Losses With Proper Gates and Risers

By Pat Dwyer

UP TO comparatively recent years foundrymen agreed unanimously that thin walled castings, notably automobile cylinder blocks, should not be shaken out until they had cooled almost completely. The impression prevailed that any casting taken out of the sand red hot was sure to develop a heat crack or a warp. Special precautions were taken to prevent premature shaking out.

To a limited extent this belief still prevails and in some instances it is justified. However, the practice of shaking out red hot castings now may be considered the rule rather than the exception. Development of an iron that will withstand sudden changes in temperature without any ill effect, followed the introduction of continuous pouring methods and these methods in turn were adopted through the necessity of conserving floor space. Incidentally, the production of superior iron has minimized the danger of cracks in the machined and asembled motors.

Present Several Views

Recent experience of the secretary of a district foundrymens association to secure data on the subject of warped castings would seem to indicate that a considerable amount of uncertainty still exists in several phases of the subject. Practical unanimity prevails in the opinion that danger of warpage always is present in long, thin, light castings. Up to the present apparently no universal method has been developed for preventing this phenomenon. Concensus of available opinion seems to be that each type of casting must receive individual treatment. Comments from five foundrymen are presented under the headings *A*, *B*, *C*, *D* and *E*.

(*A*) A considerable part of our work is along the ornamental line and includes lamp standards, brackets and columns. The castings are light in section, not over 5/16-inch, from 12 to 48 inches in length and a wide variety of styles.

We attribute part of our success to the fact that we use heavy gage steel flasks that hold their shape. However, the principal factor in the prevention of warpage is the manner in which the mold is rammed. For example, if a casting shows a tendency to dip down at the ends and hump in the center, the ends of the mold are rammed hardest in the drag, while the center is rammed hardest in the cope. Where the tendency is in the opposite direction, the procedure is reversed. If for any reason the casting must be shaken out hot, it is supported on edge instead of being left flat on the sand, either bare on one side or only partly covered.

We also make doors and frames for safes ranging in size from 6 x 16 x 24 inches to 7 x 40 x 82 inches with an average metal thickness of 3/16-inches. The molds are made in channel steel flasks. The sand is rammed hard on the inside of the pattern and the mold also is gated on the inside. Various numbers of hand ladles, depending on the size of the casting, are employed to pour the iron. The castings are not shaken out until they are cold. We have no trouble keeping them straight. Doors are handled in the same manner and must be straight to form an air tight fit in the frame and thus resist the efforts of the burgling fraternity who may seek to introduce water or nitroglycerine between the door and the frame.

Castings are poured from a fairly soft iron mixture with silicon ranging from 2.25 to 2.75 per cent. The daily production varies from 18 small to seven large frames. Loss runs from 2 to 3 per cent.

Old-Time Remedy

(*B*) My reply will be of little practical value since it only can be applied by those who already have practical shop experience and therefore presumably are familiar with the practice. We follow the line of least resistance. Where we find a casting warping, we bow the pattern in the opposite direction. The amount is based on experience. Sometimes, the warpage is caused by shaking the castings out too hot. In these instances the enthusiasm of the shakeout gang is restrained so that the castings are allowed to remain in the mold until they become cold.

(*C*) Warpage in lengthy pieces of cast iron of unequal section is caused by physical changes which occur while the metal is passing from the fluid to the solid state. It is quite generally known that an expansion takes place in the iron at the moment of solidification and, after the metal has reached a solid stage, shrinkage occurs in further cooling. In a casting with unequal section the thin parts will solidify first. While these parts are shrinking the heavier parts which are slower in solidifying actually are expanding. This simultaneous action of two opposite tendencies, shrinkage in one part and expansion in another, causes warpage.

Composition of the iron is only a minor factor so far as warpage is concerned. Iron with high silicon and phosphorus and low sulphur and manganese will warp to a less extent unter similar conditions than iron of a harder composition.

Heat conducting capacity of the mold perhaps is the most important factor to be considered. If it was possible for the entire casting to cool all over at the same speed it is possible that warpage would be prevented. There is no means of controlling the cooling in sand alone, but a method

Why Castings Warp

ANY foundry making a wide range of pulleys of various sizes and designs, from time to time will encounter trouble in cracked spokes, cracked rims and warped, distorted and strained castings. Causes of these troubles usually may be traced to faulty design, faulty molding practice, or faulty metal and often to a combination of two or more of these factors. Unequal cooling speed between different parts of the casting is the direct cause of practically all pulley troubles in the foundry. This subject was covered so ably from a practical viewpoint by H. N. Tuttle in the Sept. 1, 1927 *issue of* THE FOUNDRY *that it is included in the present article of this series.*

might be developed for the distribution of chills on the heavier sections to bring about a fairly uniform rate of cooling for the entire casting.

(*D*) Composition of the iron is responsible in many cases for the warping of castings. Another prolific reason for warped castings is the habit of taking them from the sand too soon after they are poured.

(*E*) I do not think there is a definite answer to the warping problem. Anything is possible even if it is not probable. Possibly at some time and place some person has figured out a set of rules for anticipating the warpage, but if so I never heard of it.

According to my experience the foundryman has nothing to guide him but the faculty of intuition developed through many years of close observation.

A baseball pitcher can land a ball where he wants it. He cannot transmit the knowledge to another man so that the second man can duplicate the feat immediately. The second man has to learn for himself how to coordinate the action of the various muscles involved. An experienced foundryman can look at a pattern and judge pretty closely whether or not the casting will warp if molded with proper care. Also he can take certain precautions to prevent it from warping under certain conditions. This kind of knowledge is one of the kinks or tricks of the trade and like learning to play a bass drum, only can be acquired through time and experience.

Crack the Spokes

According to H. N. Tuttle in the Sept. 1, 1927, issue of THE FOUNDRY, the most common pulley casting trouble is the breaking of the spoke near the rim. The light rim on account of its thinner section and because it is nearer the outside of the mold, cools faster than the spokes and hub. The rim becomes black hot while the spokes and hub still are red. At this stage the rim has contracted correspondingly more than the spokes. As the spokes are still red hot and in a weak almost friable condition while the rim is black and much stronger, the contraction of the rim crushes in, or shortens the spokes an appreciable distance; say, 1/64 or 1/32-inch. Due to its semiplastic condition, this does not weaken or bend the spoke.

Later, when the contraction of the rim has slowed up, while that of the cooling hub and spokes has increased, this 1/64 or 1/32-inch contraction which previously has taken place in the rim also must take place in the spokes. The result must be either a cracked spoke or a casting with an internal strain

Several remedies are available. The two most obvious are to thin the spoke, reduce the diameter of the hub, or both. If this is not permissible, or, if after it is done the trouble continues, a larger fillet where the spoke joins the rim, may cure it. The larger fillet has a tendency to throw the point of strain farther in toward the bottom part of the casting, which may stretch slightly. Also it spreads the strain over a slightly larger area.

However, a more certain way is to add a small thin brace that will tie the spoke to the rim. This brace should be made quite thin, so that it may cool off quickly, and thus be strong enough to resist the cracking strain at this point.

Figs. 119 and 120 show this brace, or bracket, and an easy way of attaching it to split iron patterns or to any metal pattern.

Cast in Wood Molds

The brace is shown at *A* Fig. 119 while *B* shows a longitudinal section. The pattern for the brace or fin is cast around the brads *CC*, which are driven tightly in the drilled holes previously made in the correct location in rim and spokes.

Two halves of the wood mold in which the brace is cast are shown at *DD*, Fig. 120. Common half and half solder is a convenient metal for casting in wood molds. It melts at a low temperature and will not scorch the wood. The wood mold made in two blocks as shown simplifies the carving. The joint also makes a perfect centerline for locating the mold correctly upon the pattern, as well as a convenience in removing the mold. *E* shows the pouring sprue. *F* is a wedge for clamping the mold to the pattern.

Sometimes the spokes instead of breaking will pull the rim in at the end of each spoke as in Fig. 121. In instances of this kind where it may not be permissible to thin the spokes, an equal cooling rate may be secured by chilling the spokes as shown in Figs. 121 and 122.

A long chill, *A*, Fig. 121, and *B*, Fig. 122, was placed on each spoke in the drag mold only and rammed in place. After the pattern mounted on a hand stripper was drawn, the chills were removed from the pattern and placed in their impressions in the drag mold.

This equalized the cooling so well that the castings were not out of round to exceed 1/64-inch at any point.

Another method of equalizing the cooling is to uncover the hub, leave the rim covered, and if necessary, remove the core, and even pour water on the hub and spokes. A little experimenting along this line generally

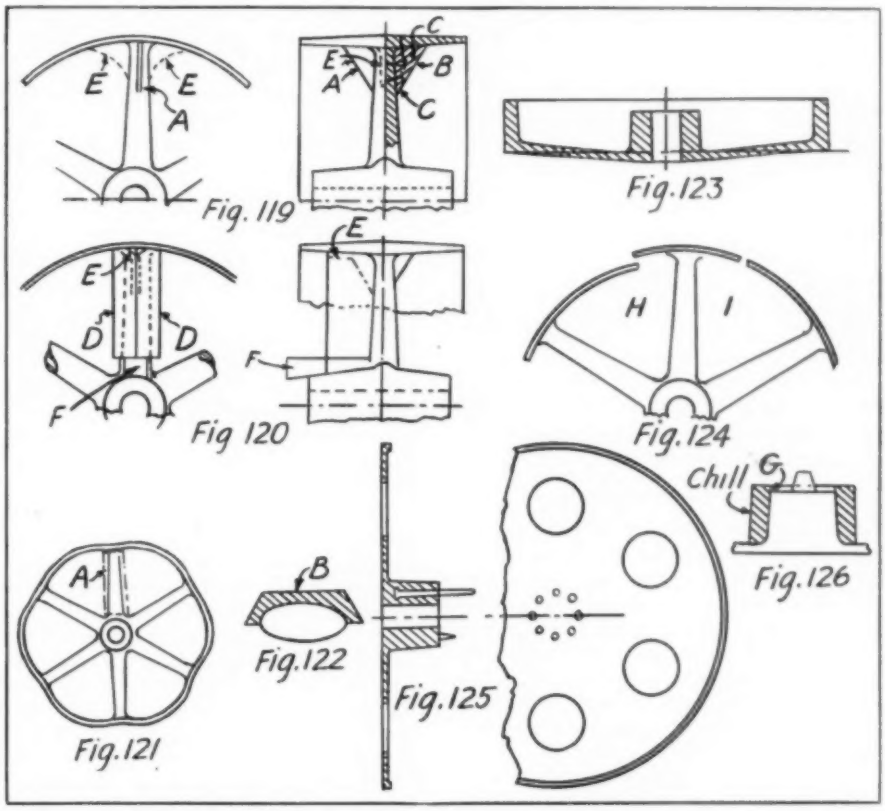


Fig. 119—Plan and Side View Illustrating the Use of a Brace. Fig. 120—Similar Views Showing Application of Wood Molds. Fig. 121—Exaggerated View of Pulley in Which Arms Did Not Crack But Pulled Rim Out of Shape. Fig. 122—Chill for Cooling Arm. Fig. 123—Thin Arms and Hub on Pattern Casting Bowed in Center. Fig. 124—Long Heavy Arms Crack the Rim. Fig. 125—Nails Inserted in Hub Prevent Distortion. Fig. 126—Sometimes It Is Necessary To Chill the Hub on the Outside

is necessary on nearly all jobs.

A chill cast around the hub sometimes will cure this trouble. If this expedient is resorted to, care should be taken to make the chill extend beyond the hub about ⅛-inch, as shown at *G*, Fig. 126. If the chill is flush with the end of the hub, a little iron may run over the end of the chill, make it hard to remove and sometimes ruin the chill.

Sometimes a small chill applied right over the cracking point will save the casting.

While the foregoing reasoning is based upon the effort to obtain uniform cooling, some foundrymen make the spokes heavier on the theory that if the spokes are increased enough to pull in the rim rather than crack, the remedy is good enough. This may be true with small pulleys, but in larger ones it produces the trouble shown in Fig. 121, and in any case it adds to the cost of the pulley.

If it is known when making the master pattern that there is danger of a spoke crack near the rim, a thin fillet rib, as shown at *EE*, Fig. 119, may be put in the pattern. This rib looks better than the braces shown at *A* and *B*. It is hard to put in a split iron pattern, but easily is applied to the master patttern.

Cause Cracked Rims

Spokes too light in proportion to the rim sometimes cause the rim to crack, but more often throw the pulley out of round. The casting will resemble that in Fig. 121, except that the rim will be high at the ends of the spokes instead of in between. The rim, cooling last and stretching across from spoke to spoke, makes the diameter less between the spokes.

If the rim cracks, the crack will open up, as shown at *I*, Fig. 124. When the rim is cracked and does not open, but on the contrary pinches tightly together and even shucks by, as shown at *H*, Fig. 124, it is apparent that the spokes are too heavy for the rim. If the force which cracked the pulley at *H* is great enough to let the parts pass by as shown, then the internal strain of a too heavy spoke or hub will draw the rim in, as shown, and relieve the strain in the same way as a broken spoke. In case of doubt, it will be well to make an experimental casting to be altered by some simple molding expedient, before permanently altering the metal pattern.

A pulley flange or central web cast separate from the pulley caused a good deal of trouble by distortion. It is shown in Fig. 125, a thin plate about 16 inches diameter, 3/16-inch thick with a hub of about 11/16-inch metal. The castings came so badly warped or *fluttered*, to use a wood patternmaking term, that it was impossible to use them.

A row of cast iron nails was inserted in the hub as shown, whereupon the castings came out perfectly true. Eight small prints were placed on the pattern to show the molder where to set the nails.

Distortion of this casting came rather later than we had supposed in experimenting, several castings were shaken out hot and stood edgewise, vertically in the sand heap to cool. They remained straight until cooled to almost deadblack and we thought we had found a remedy. Much to our surprise and disappointment we found them warped as much as usual when cold.

Castings Heat Treated

In making a cast iron half pulley for a pattern, where the rim had to be extra heavy on account of double finish, the half spokes long and light with a file finish only, the castings were warped to such an extent that the spokes in the center were bowed up on the parting side more than the thickness of the half spoke as shown in Fig. 123.

Several of these castings were placed in an oven, heated red, taken out and clamped to a surface plate and then returned to the oven. They were allowed 24 hours to cool and then taken out. When the clamps were removed the castings were found to be perfectly flat. They were finished for patterns and never have shown any disposition to warp since.

Sometimes a pulley from a certain pattern will crack when it never has done so before. In this case it is well to look to the metal mixture. Changing the molding methods also may make trouble. The gating sometimes affects the strain. Where the rim is too light, a runner sometimes is carried all around the pulley and several gates cut in, as in gating hollow ware. This holds the heat in the rim, but is expensive as it takes a larger flask and makes more waste iron.

If a casting is found to be cracked, strained or warped, it is well to study the problem in the light of unequal cooling. If the design can be changed, this is the easiest way to handle the case. If this is not possible, then various molding methods, application of chills, cooling fins, uncovering, watering, regating, strengthening ribs, using internal chills, coring out heavy metal, etc., should be considered and the most feasible tried out, experimentally, until the necessary relief is obtained.

In extreme cases it may be better to change from spokes to a web. A web, reasonably well designed, seldom causes trouble, unless the holes are too large, or too close together. In fact, a web pulley has an advantage when mounting on a stripper. The whole web acts as a stool plate and can be finished in a lathe thus eliminating the expensive hand work of filing the spokes and fitting the stool plates between them.

Oval spokes in extreme cases may be changed to *T* or *H* section to make them cool faster without reducing their strength. If the spokes are too light they easily are made heavier, but it is always well for economy to try the lightening methods first. The question is one of ratio, or relation of one part to another. Making one part lighter is the same as making another part heavier, when it comes to even or uneven cooling.

Book Review

Ford Men and Methods, by Edwin P. Norwood, cloth, 5½ x 8½ inches, published by Doubleday, Doran & Co., Inc., Garden City, N. Y., and supplied through THE FOUNDRY, Penton Building, Cleveland, for $2.00 plus 15 cents postage and in London by the Penton Publishing Co., Ltd., 416-17 Caxton House, Westminster.

This volume should prove interesting to many who look with wonder upon the gigantic, world wide industrial organization which has been built by Henry Ford. Writing in a popular vein, the author has painted a general picture of some of the spectacular as well as the commonplace characteristics of the Ford organization.

The transportation of materials through the entire plant over a conveyor system which might be compared "to a river with many tributaries, but all flowing toward a single point" ranks first in the arrangement of methods discussed. From there, the author describes the movement of hundreds of tons of raw and finished materials, outside the plant, using practically all means of modern commercial transportation facilities and employing a predetermined and carefully controlled schedule that eliminates waste of stored materials and double handling. Other chapters discuss the movement of men in and out of the plant, methods employed to keep the plant clean, the health of the worker and its relation to production, safety, the traveling lunch wagons, methods of making up the payroll, salvaging operations, and the Ford trade school.

Feature Casting Design at A. S. M. E. Meeting

The importance of close co-operation between the designer and the foundryman was stressed at the recent annual meeting of the American Society of Mechanical engineers in New York. At a special session arranged by the machine shop practice division of the society, Alex Taub, research engineer, Chevrolet Motor Co., spoke on "Correlation of Casting Design and Foundry Practice." Mr. Taub pointed to several instances in the automotive industry where bad foundry practice may be eliminated by proper considerations of design. He stated that

elimination of foundry difficulties means elimination of trouble to the ultimate consumer, and that therefore the foundryman and engineer are interested equally in the final result.

While foundry practice differs to a more or less degree almost to the extent of the number of foundries, it was the unanimous view of those taking part in the discussion on Mr. Taub's paper that closer co-operation between casting designer, patternmaker and foundryman was desirable. This appears to be fully as important for jobbing and specialty foundries as in the automotive field.

B. P. Graves, Brown & Sharpe Mfg. Co., Providence, R. I., presided at the casting and machine design session, and, opening the discussion, stressed the importance of calling in the foundryman during the process of pattern designing as a check against foundry practice. E. R. Glynn, S. L. Allen Co. Inc., Philadelphia, agreed, pointing out that while problems differ for a shop purchasing its castings, the importance of correlation between the foundry and the casting design department was no less a factor in successful operation. C. C. Ross, Kellogg Mfg. Co., Rochester, N. Y., touched on the likelihood of more machining on cheaper castings, urging collaboration not only with the foundry, but also with the pattern department. The cheapest casting per pound is not always the cheapest in the end, he claimed.

Max Sklovsky, Deere & Co., Moline, Ill., expressed the opinion that designers in many instances were behind in foundry practice. He favors representation of the factory and foundry in the design department with a chance of eliminating many difficulties. R. A. Bull claimed foundry practice differs, in some minute detail at least, in most of the 5000 foundries. Steel founders, he knew, are especially willing to give their views on design, every miscellaneous casting being a problem in itself and best results are obtained by calling in the foundryman. Foundry equipment enters into the economic result, and he believes designers should be familiar with the foundry equipment. Buyers of castings in the course of a year take enough castings to warrant a close contact with the foundry and when a purchaser changes his foundry as a source of supply it is natural that ideas of the new foundry will be different from the old, making it all the more important to call in the foundry experts as to design. Albert Palmer, Crompton & Knowles Co., Worcester, Mass., also agreed with the previous speakers.

Hunt Defects with Large X-Ray

HIDDEN defects in castings, welds and electric machinery, hitherto difficult or impossible to detect visually or by ordinary methods, now are revealed by the spotlight of the X-ray in the largest laboratory of its kind in industry, recently added to the manufacturing facilities of the General Electric Co., Schenectady, N. Y. The laboratory is equipped completely with a substation, rooms for taking X-ray pictures, photographic darkroom and air conditioning plant.

A 200,000-volt X-ray tube is used, the highest voltage rating commercially available, the equipment being the standard hospital deep therapy type built and installed by the General Electric X-ray Corp., Chicago. Products varying in size from small devices to castings weighing many tons can be photographed. Two rooms are provided for this purpose, one about 11 feet square by 9 feet in height for the small equipment, and the other approximately 24 by 26 by 17 feet high, for large castings and machines.

Shield Rooms With Lead

In operation the piece to be photographed is set in place, the film put in position and the X-ray tube placed at the proper point by an overhead suspension system in the large room and a standard hospital therapy mounting in the small room. Because of the high-voltage X-rays employed, both rooms are shielded carefully with lead lining on the roof and walls, lead sheets ¼ and ⅛-inch thick being held in place by lead-headed pins. This lead lining extends into the ground about 4 inches. While the X-ray photograph is being made the operator can watch the equipment through a suitably located window of lead glass. Experience at Schenectady has shown that it is desirable to give a 5-minute exposure at low voltage in making pictures where a longer time is not needed, as photographs with greater contrast are produced at the lower voltages. Where it is necessary to make longer exposures, because of the nature of the work, the voltage is increased to the full 200,000 and the time extended as necessary.

One of the accessories in the laboratory which has been found particularly valuable is a stereoscopic viewing equipment. By taking two X-ray photographs from slightly different positions in a manner analagous to the operation of a pair of human eyes, and then placing the negatives in this equipment, an effect of depth is created. Thus the analyst can look into the casting or device and see structural details ly-

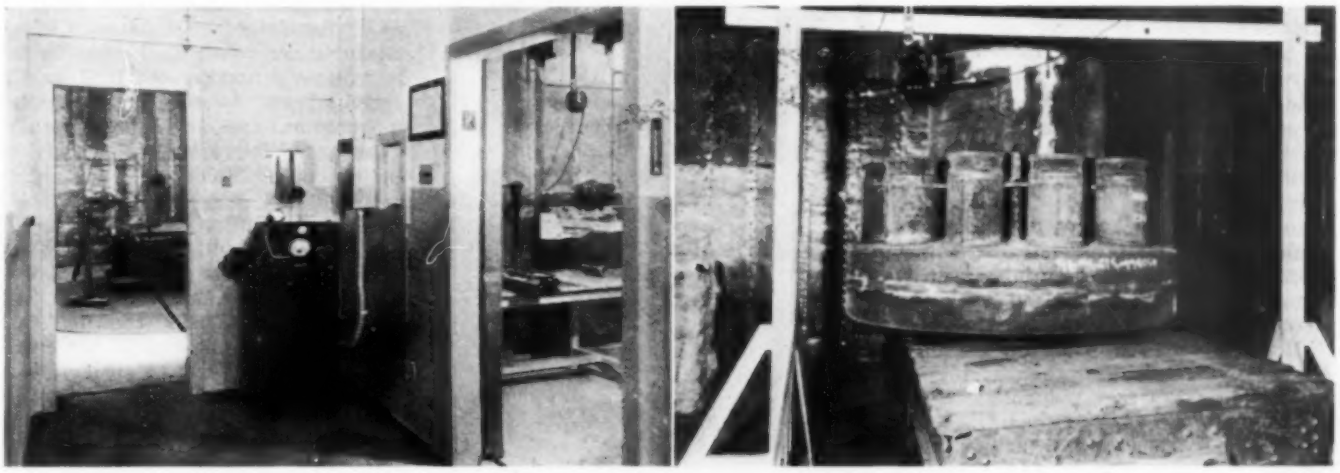


Fig. 1 (Left)—General View of X-Ray Laboratory Showing Large and Small Photographic Room and Control Stand. Fig. 2 (Right)—Large Casting in Place for Photographing. X-Ray Tube Is Shown at the Top

ing in their proper relative positions.

The laboratory already has been of great assistance to the manufacturing organization at Schenectady. A wide variety of objects has been photographed, including castings, welds, forgings, different types of raw steels, alloys, and other metals.

Other recent cases include the examination of cast tool steel as part of the raw material inspection, inspection of a mercury arc rectifier assembly of rolled plate stock, study of a ball bearing assembly for a motor, the comparative tests of welds made by different processes, and other weld inspections, and the examination of a defective casting of considerable size which had been salvaged by welding, to determine whether salvaging was a success.

Gray Iron Institute Studies Test Bars

ONE difficulty in the past betweeen the foundryman, and the engineer or the designer has been the inability to discuss gray iron strength properties in the same terms. The engineer or designer referred to the tensile strength while the foundryman spoke about the transverse strength. The transverse test has the advantage in that it is comparatively simple to make, but more important, considerable data gathered over a period of years on that type of test are used as a guide in controlling the cupola mixtures. Its disadvantage is that it cannot be translated accurately into the engineer's fundamental test, tensile strength.

Another source of difficulty has been the tendency of the engineer or designer to assume that gray iron is one material rather than a series of materials which can be made to vary widely in their properties. A third trouble has been the lack of agreement between gray iron metallurgists on whether one test bar for tensile strength, and one bar for transverse will fill all testing purpose needs, or whether a series of bars of different sizes should be made.

Institute Collects Data

Progress made in the field of gray iron during the past several years has demonstrated that it can be made to fill a variety of needs, but the engineer or designer has been slow to take cognizance of that progress. That may be due to his conservatism, the fact that he has not been apprised of the progress made, or to difficulties outlined previously. For some time the Gray Iron institute has been engaged in supplying foundrymen and engineers with data on the properties of gray iron. Recognizing the importance of standard specifications to engineers, the Gray Iron institute has engaged in a program to establish such data. In that work, part of which has been completed, the institute considered all possible factors relating to gray iron.

Realizing that gray iron is a family of materials rather than a single entity, the Gray Iron institute divided it into four grades according to tensile strength as follows: 20,000; 30,000; 40,000; and 50,000 pounds per square inch. After studying the test bar situation, the committee composed of representatives from the Connecticut, Buffalo, Cleveland, and Chicago districts, began in June, 1931, a comprehensive investigation of test bar dimensions, etc. The work was finished, and the conclusions presented at the October meeting of the institute held at West Baden, Ind. These established four sizes of test bars for tensile strength, and five for transverse strength. The tensile bars are cast to shape in dry, oil-sand cores. Only a skin cut is necessary in machining before testing. The diameters and lengths of the bars vary as follows: As cast, 0.875-inch diameter, 5 inches long machined to 0.800-inch diameter, 4 inches long; as cast, 1.2-inch diameter, 6⅜ inches long machined to 1.10-inch diameter, 5.72 inches long; as cast, 1.7-inch diameter; 8⅛ inches long machined to 1.55-inch diameter, 8 inches long, and as cast, 2.05-inch in diameter, 10½ inches long machined to 1.86-inch diameter, 9⅜ inches long.

The transverse bars correspond in diameter to the tensile bars, but have the same cross section throughout. The 0.875-inch bar is cast 15 inches long and tested on 12-inch centers; the 1.2-inch bar is cast 21 inches long and tested on 18-inch centers; the 1.7-inch bar is cast 21 inches long and tested on 18 inch centers. As yet it has not been decided whether to cast the 2.05-inch bar 21 or 24 inches long, tested on 18 or 21-inch centers respectively. In addition to those bars, one 2.2-inch in diameter, 28 inches long and tested on 24-inch centers is specified for heavy work. The transverse test bars are cast in dry sand molds made of heap sand.

Iron Control Is Necessary

Compare the Sizes

Comparison of the various bar sizes shows a relationship between them with respect to the volume under the gage length. As near as can be ascertained for practical purposes, if the volume under the gage length of the 1.20-inch bar is assumed to be 1, the 0.875-inch bar is ½, the 1.7-inch bar is 2½, and the 2.05-inch bar is 4. The idea behind the relationship is that the solidity and the cooling conditions of the various sized bars will be comparable.

While eventually, a designation will be established between the test bar size, and the section thickness of castings, that phase is not quite completed although considerable work has been done. The final outcome of the investigation on test bars, it is expected, will enable a casting consumer to specify a certain tensile strength for a certain sized bar, which he in turn knows from experience or otherwise, will indicate an iron suitable for the type of castings he desires. Incidentally, foundries may classify their mixtures according to the tensile and transverse strengths obtained on the various bars. In addition, from that information and their own foundry experience, foundries can decide on their most profitable castings field.

Wm. H. Muller & Co. Inc., 122 East Forty-second street, New York, has appointed the following district agents to its pig iron sales: Carson, Marshall & Co. Inc., Franklin Trust Co. building, Philadelphia, for Pennsylvania, Delaware, Maryland and Southern New Jersey; Phillips Isham, 30 Church street, New York, Northern New Jersey and Connecticut; and William J. Breen, 192 Parkway, Winchester, Mass., Rhode Island and Massachusetts.

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Sand Is Unsuitable

Can you tell us what is the cause of a heavy scale that appears on all our gray iron castings between ½ and 1 inch in thickness?

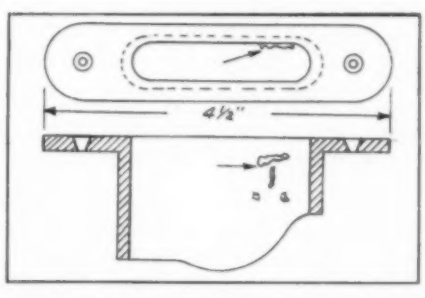
If by scale on the castings you are referring to a rough coating, or a rough surface which detracts from the appearance and defies the ordinary cleaning methods, it is caused by the use of sand which is not sufficiently refractory for the purpose. In plain nontechnical language the scale is a slag fused from the sand and incorporated with the surface of the molten metal. The only cure for it is to use a different grade of sand. A sand more highly refractory in character and a sand with a minimum amount of clay bond.

Q & A

Castings Are Rough

Under separate cover we are forwarding two small castings and will appreciate your opinion on the probable cause of the rough spots on the interior of each. To some extent this form of defect appears in every heat, but it has increased to an unreasonable extent during the past two months. The molds are made on a jolt squeeze machine and the core is green sand. The sand shows a moisture content of 6.3 to 6.7, permeability 15 and green compression 6.3. We are wondering if the defect is caused by soft ramming, dirty sand or vegetable matter in the sand. Do you think the trouble could be traced to a clay mixture added to the heaps some time ago to increase the bond.

The defect shown on the two castings might be due to any of the three causes you mention, soft ramming, dirty sand or vegetable matter, but in view of the various points of evidence submitted, we believe that another factor is responsible. The beautiful, symmetrical and uniform walls of the casting indicate that the sand has been rammed to the proper density. Had any vegetable matter been present in the sand it would have caused a commotion in the molten iron and this commotion in turn would have been reflected in small blowholes. With these two potential causes eliminated from the problem, the third factor, dirty sand, remains. Dirty sand is an exceedingly comprehensive term. It may refer to sand containing metal or other foreign inclusions. It may mean a sand containing an undue proportion of dust, silt or fines. It may mean a high bonded sand with a tendency to—if we may use the term—coagulate and form lumps of different sizes. On the outside of the casting the sand has an opportunity to spread and the presence of one or more of these lumps does not affect the face of the casting. On the inside the opportunity for assimilation is limited and the lump serves as a covering for a miniature cave. Later. the iron enters this cave and forms the unsightly defect on the inner face of the casting. Obviously the remedy is to use sieved sand to form the core. Also, as an added precaution, the sieved sand should be thrown into the pattern by hand, before the sand is riddled over the remainder of the pattern.



Form of Defect Indicated by the Arrow Appeared Only on a Small Area

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions must be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Calculates Stresses

One of our customers produces a steam trap which is spherical in shape. He knows by actual experience that this trap stands a pressure of 100 pounds above its requirements, but would like to know the actual capacity of this trap. We would appreciate knowing what the formula is for proportioning the wall thicknesses of such a casting with the pressures to be used.

We do not have any exact data on the method used in determining the wall thicknesses of castings such as you mention, but we believe that they are based upon formulas for determining the collapse of tubes. For example, Kent in his *Mechanical Engineers' Handbook* gives the following formula for the collapse of tubes with spherical ends:

$$St = 1/3\ P_1\ (2r_2^3 + r_1^3) \div (r_2^3 - r_1^3)$$

Where St = unit stress
P_1 = internal pressure
r_1 = inside radius
r_2 = outside radius.

To illustrate the application of the

above formula the following example will be taken:

Working pressure—300 pounds per square inch.
Diameter of the sphere—4 inches.
Wall thickness—¼ inch.

Substituting the various values in the proper places in the formula, the unit stress is about 1700 pounds per square inch. Comparisons of that figure with the tensile strength values of ordinary gray iron with a minimum of 21,000 pounds per square inch, you can see that there is a safety factor of 12. Compared with the minimum required tensile strength for high test gray iron given as 30,000 pounds per square inch, the safety factor is about 17.

Problems in Nonferrous Founding

By Charles Vickers

Brass Disks Crack

We are having trouble making small yellow brass disks that form covers and are adorned with lettering and a raised space across the middle for carrying the number which is stamped in. This slightly heavier space persists in showing a series of cracks which spoil it for stamping. We have tried the addition of aluminum, from 1 to 4 ounces, but the castings would not run at all until we got up to 2 ounces of aluminum. We have also tried tin to stop the cracking, but without any apparent improvement.

In the case of an aluminized brass better results will be obtained in making castings provided the zinc content is maintained at, or near to the 40 per cent mark than when it is lower than the 40 per cent. About 2 per cent lead can be added when aluminum is used for a deoxidizer and fluidizer, making a mixture something on the order of 40 per cent zinc; 2 per cent lead, and 58 per cent copper, plus aluminum.

To prevent cracking change the gates and instead of two gates for the pattern use one, and locate it on the side of the cover at one end of the number thickness and have it slightly broader than the gates now used. However, this change will not prevent the cracks in itself. To prevent cracking feed that section of the casting, for the cracks are an expression of shrinkage only. Shrinkage can be controlled by putting a shrink ball on the gate in the cope part, and place the shrink ball as close to each pattern as will allow the gate to be removed easily.

In making a shrink ball it is not enough to cut out a little sand in the cope with a gate-cutter. Have a cone shaped pattern turned up of wood, and shellac one to each pattern in its proper place. The size of the cone will have to be obtained by the trial and error method, but that is not a lengthy process. It is possible that putting a high cope runner on top of the drag runner would feed the castings and prevent shrinkage. If a 60/40 brass is used, no lead, no aluminum, but from 4 to 8 ounces of 10 per cent silicon copper instead of aluminum, the chances are that the metal will run and there will be no shrinkage without making any other change. With lead, the silicon copper cannot be used, so do not try it.

Q & A

Mixture Is Wrong

We are forwarding for your inspection a casting made from an alloy consisting of 90 pounds of alloy containing 94.4 per cent copper, 4.5 per cent silicon, and 1.1 per cent manganese, and 10 pounds of phosphor-copper. The latter is added to harden the alloy, but all the castings come out porous. The metal is melted in a gas-fired furnace with a 20-pound gas pressure, no blower. The first heat takes 2 hours and 55 minutes, and the remainder 1 hour and 55 minutes. Charcoal is used as a cover with a proprietary flux. A fine grade of sand from Ohio is used, and we work the facing on the dry side.

Your trouble lies partly in the alloy and partly in the furnace. It is doubtful whether the present alloy could be cast without having difficulty due to porosity because of the conflicting elements entering into its composition. If the original 94.4 per cent copper, 4.5 per cent silicon, and 1.1 per cent manganese alloy is not hard enough, we suggest that you obtain information from the maker on the proper way to make it harder, or let him supply you with harder ingots. If gates, risers and other return scrap have been added to other heats, there is a possibility that the entire amount of metal in the foundry is contaminated.

The melting time given indicates that you are using a reducing flame which also will cause porosity in the metal. The partly unconsumed gases present are greedily absorbed by the metal, and your trouble will continue until you change to a slightly oxidizing flame. Undoubtedly, it will be necesary for you to purchase a blower to supply the proper amount of air to the burner, and it should reduce your melting time to about an hour. Use of charcoal as a cover is all right, but a thin coating of broken bottle glass will be better, as it will remain on the metal. Do not use too fine a sand for your work. Use a sand corresponding to No. 1 Albany for the 2-inch diameter, 2-inch long cylinders.

Q & A

Core Needs Venting

We are having difficulty with leaky stuffing box castings which are subjected to pressure as you may observe from the accompanying casting. You will note that the entire casting is porous, but the holes are so small that when the castings are machined, they have a speckled appearance. We have tried various means to overcome the difficulty without result. We have molded the casting with the stem in the drag and in the cope, tried skim gates, used the best of virgin metals, used dry sand cores instead of green sand cores, and have cored out the stem. An oil burning furnace is used, and 250 pounds of metal are melted in 30 to 35 minutes. The metal is covered with a purchased flux and a little charcoal added. Broken glass also has been tried as a cover, but spongy castings resulted. A number of different alloys have been tried without success as the porosity continues. We cannot believe that our difficulty lies in the metal used or in the crucible, neither do we feel that our trouble lies in the molding, gating, in the moisture content of the sand, or in venting. We are having our oil analyzed to check its 0.5 per cent sulphur content.

The casting resembles a flanged nut, or pill box in contour with a stem about 1-inch in diameter and 1½ inches high projecting from the top. It is molded with the stem in the cope, and the drag contains a green sand core about ⅝-inch in height and 2 inches in diameter for lightening purposes. Examination of the casting indicates to us both mold and core, particularly the core, causes the porosity although that does not coincide with your belief. Even though, you have tried dry sand cores to eliminate the trouble, it is possible that you overlooked an important feature, and that was proper venting of the core to the atmosphere.

It is suggested that you try the following sand mixture for the drags which will not require venting with a wire: 10 parts fine molding sand, 5 parts fine silica sand, and 1 part ground clay. Mix thoroughly to the consistency of your regular sand. Fill the drags with sand mixture, and do not place them on a solid bottom board, but use a well perforated plate to permit free exit for the gases.

What Oxidized Scrap Can Do To Iron

By Garnet Phillips

DURING the production of some castings used for weights, and employing the most economical scrap iron available as raw material, some unusual chilling phenomena were observed. The scrap metal used consisted of gray iron parts that had been oxidized more or less in service, such as stoveplates, grate bars, conveyor chain links used in heat treating furnaces, etc. which were mixed with scrap castings that had not been subjected to excessive oxidation. That type of raw material was used exclusively since the castings made with it had metal sections ranging from 0.75 to 2.0 inches, and did not have to be machined. Typical chemical analyses of two lots of the scrap are as follows:

Element	Lot A	Lot B
Silicon	2.05	1.90
Total Carbon	3.16	3.14
Sulphur	0.093	0.127
Phosphorus	0.616	0.490
Manganese	0.51	0.46
Nickel	Trace	Trace

The metal was melted in a cupola lined to 36 inches. The depth of the well from sand bottom to slag hole was 12 inches, and the coke bed used was 40 inches above the tops of the tuyeres before charging was started. The coke to iron ratio between charges was 1 to 8.5. Fifty-eight pounds of limestone and 5 pounds of fluorspar were used with each charge. The cupola was operated at nearly its normal melting rate for about 1 hour in the morning to pour off quickly the molds already put up, and then was operated at a low melting rate during the remainder of the day.

When operating the cupola at full capacity of 5.5 to 6.0 tons per hour, the air volume used ranged from 3200 cubic feet of air per minute. The air volume used to obtain the iron to be described varied from 2800 to 2900 cubic feet per minute for the first hour, to 800 to 1000 cubic feet per minute during the remainder of the day. The average melting rate during a day's run was 2.54 tons per hour, and the operation of the cupola was such to insure the minimum of oxidation of the metal being melted.

Check Metal Characteristics

The molten metal was checked once in the morning and once in the afternoon by pouring chill test bars and transverse test bars. The chill test bar measured 1.5 inches square and 6 inches long, and was poured against a cast iron chill 2 inches thick. The transverse bar was 1.2 inches in diameter, and 21 inches long. The pouring temperatures of the test bars were nearly the same since the tapping temperature varied between 2680 and 2720 degrees Fahr., and the chill test metal was taken from full 900-pound capacity ladles carried the same distance from the cupola in each case before pouring.

Chill tests during the first two days showed normal fractures for the analyses obtained. The chill test data, analyses, and transverse strengths were as follow: Silicon, 1.58 per cent; carbon, 2.99 per cent; sulphur, 0.160 per cent; phosphorus, 0.507 per cent, and manganese, 0.33 per cent. The transverse strength was 2000 pounds with a deflection of 0.23-inch, and the chill test showed a white fracture $\frac{7}{8}$-inch and a fine gray fracture $\frac{5}{8}$-inch.

Tests were made in the morning and afternoon of the second day with the following results: Morning, Silicon, 1.10 per cent; carbon, 3.02 per cent; sulphur, 0.163 per cent; phosphorus, 0.518 per cent, and manganese, 0.30 per cent. The transverse strength was 2280 pounds with a deflection of 0.19-inch. The chill fracture showed $\frac{7}{8}$-inch white with $\frac{5}{8}$-inch light gray and mottled. The afternoon test gave the following: Silicon, 1.18 per cent; carbon, 3.07 per cent; sulphur, 0.172 per cent, phosphorus, 0.503 per cent, and manganese, 0.36 per cent. Transverse strength was 2280 pounds with a deflection of 0.22 of an inch. The chill fracture showed $\frac{3}{4}$-inch white, $\frac{1}{8}$-inch mottled, and $\frac{5}{8}$-inch fine gray structure.

The third day's chill test gave an all white fracture and the data are as follows: Silicon, 1.30 per cent; carbon, 3.13 per cent; sulphur, 0.152 per cent, phosphorus, 0.437 per cent,

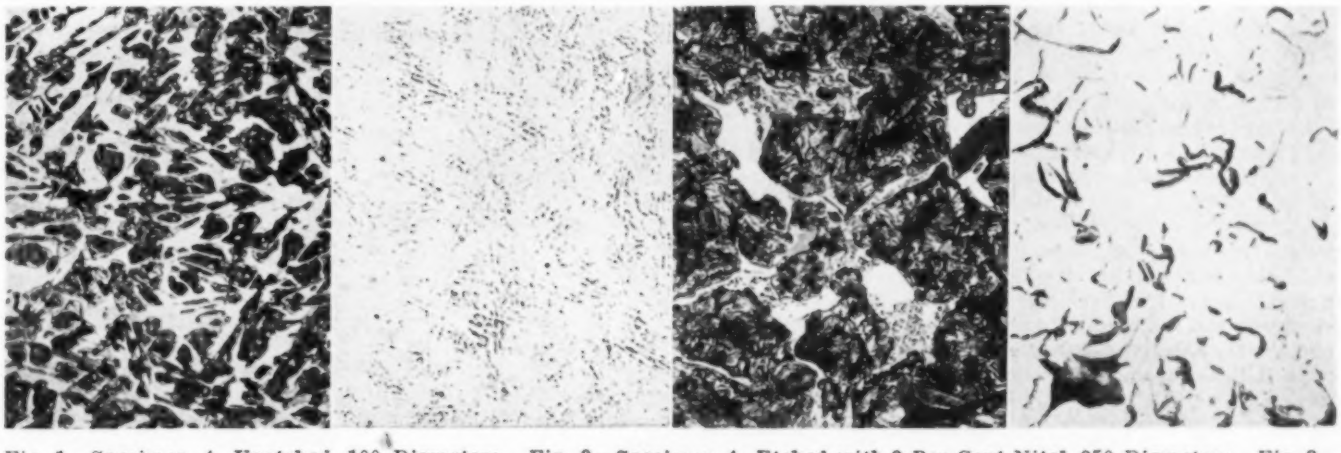


Fig. 1—*Specimen A, Unetched,* 100 *Diameters. Fig.* 2—*Specimen A, Etched with* 2 *Per Cent Nital,* 250 *Diameters. Fig.* 3—*Specimen B, Unetched,* 100 *Diameters. Fig.* 4—*Specimen B, Etched with* 2 *Per Cent Nital,* 250 *Diameters*

and manganese, 0.36 per cent. The transverse bar was defective due to dirt, and as mentioned, the chill bar showed a white structure throughout the 1½-inch bar. As may be seen, the chemical analysis indicates a softer iron with less tendency to chill than that which was obtained on the previous day. Examination of the sprues revealed them white throughout while the heavy castings were mottled. Investigation showed that the scrap used as raw material on the third day was almost entirely heat treating furnace chain links which had been highly oxidized.

Add Silvery Pig Iron

A small amount of silvery pig iron was added to the charges for the following day's heat with the following results: Silicon, 1.36 per cent; carbon, 2.98 per cent; sulphur, 0.125 per cent; phosphorus, 0.499 per cent, and manganaese, 0.31 per cent. The transverse strength was 2070 pounds with a deflection of 0.20-inch. The chill test was white throughout except for a small gray area 3/16 x ¾-inch long near the side opposite the chill.

While a slight improvement was noted, it next was decided to substitute some unoxidized gray iron scrap for some of the oxidized material. Twenty per cent of scrap of the following analysis was placed in the mixture:

Element	Per cent
Silicon	1.85
Total Carbon	3.24
Sulphur	0.106
Phosphorus	0.825
Manganese	0.40
Nickel	Trace
Chromium	0.02

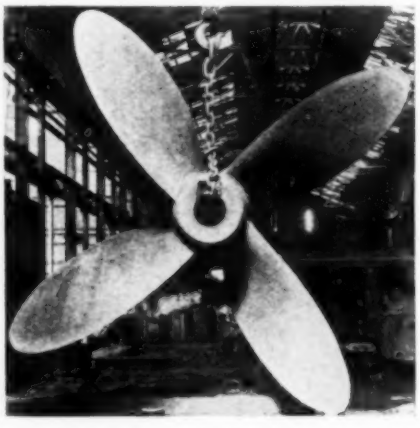
The data obtained on the fifth day were as follows: Morning tap—Silicon, 1.36 per cent; carbon, 3.07 per cent; sulphur, 0.086 per cent; phosphorus, 0.556 per cent, and manganese, 0.31 per cent. The transverse strength was 2250 pounds with a deflection of 0.21-inch. The chill test showed ¼-inch white, ½-inch fine gray, and ¾-inch coarser gray. The afternoon tap showed: Silicon, 1.38 per cent; carbon, 3.05 per cent; sulphur, 0.145 per cent; phosphorus, 0.499 per cent, and manganese, 0.34 per cent. The transverse strength was 2150 pounds with a deflection of 0.20-inch. The chill test showed ⅜-inch white and 1⅛ inches fine gray.

Substitution of unoxidized scrap proved effective in restoring a normal gray fracture. Later, the tests were repeated. A white fracture chill test bar was obtained, and the normal gray fracture restored by changing the mixture. However, the chemical analysis did not at any time indicate that those irons which gave a white fracture would chill any more readily than iron which gave a gray fracture. Micrographs obtained from two of the chill test bars illustrate the chilling phenomena clearly. The areas photographed were about ½-inch from the side opposite the chill. The unetched and etched specimens are shown in Fig. 1, 2, 3 and 4, and the analyses are as follows: Specimen A—Silicon, 1.36 per cent; total carbon, 3.28 per cent; sulphur, 0.183 per cent; phosphorus, 0.515 per cent; manganese, 0.33 per cent, and nickel, 0.09 per cent. Specimen B—Silicon, 1.50 per cent; total carbon, 3.30 per cent; sulphur, 0.148 per cent; phosphorus, 0.387 per cent; manganese, 0.24 per cent, and nickel, 0.13 per cent.

Unetched micrographs show *A* to contain fairly discontinuous graphite particles while *B* is practically free of graphite. The etched micrographs show *A* contains a matrix of fine pearlite interspersed with carbide areas with a few dove-gray areas of sulphides while *B* consists of about equal parts of fine pearlite and cementite. The amounts of silicon, carbon, sulphur and manganese in the irons would lead one to expect them to behave similarly in regard to chilling, but the reverse is true. Data obtained from the tests indicate the danger in using large quantities of oxidized scrap in mixtures intended to produce gray iron of any quality. It is suggested that the amount of dissolved iron oxide in the remelted iron is the controlling factor causing the white instead of gray fracture.

Casts Large Propeller

Messrs, Smiths & Co., Ltd., Nile street, South Shields, Eng., recently cast what is believed to be the largest cast iron propeller ever made on the northeast coast of England. The casting weighs 34,720 pounds, is 20 feet in diameter, 14 feet 6 inches on the square and has a surface area of 108 square feet.



Four Bladed Propeller Cast in English Shop

The propeller was made for a ship which was constructed on the Clyde. The casting was molded in 5 days and was made in loam and poured through pop gates in the hub. Castings of this type are poured from a basin at the side of the mold connected to the gates by a long runner. The metal is introduced into the mold as easily as possible and the gates, basin and runner are kept full to exclude scum from the casting.

Plan Exchange Papers

The American Foundrymen's association, through its technical secretary, R. E. Kennedy, has announced the authors of two exchange papers for 1932. F. A. Melmoth, Detroit Steel Castings Co., Detroit, will prepare the exchange paper for the Australian association. R. S. MacPherran, Allis Chalmers Mfg. Co., Milwaukee, will write the annual exchange paper for the convention of the Institute of British Foundrymen. Mr. MacPherran will discuss high test cast iron.

Operate Stove Foundry

Steady growth and expansion have marked the progress of the Hardwick Stove Co., Cleveland, Tenn., from a two-man shop at the time of its founding in 1879 to its present position as a nationally known institution, one of the greatest stove manufacturing plants in the South with 750 men on the payroll. The company was founded by C. L. Hardwick Sr., assisted by his son, J. H. Hardwick. A grandson, Col. C. L. Hardwick, third in line of succession, now is serving as president of the organization. He joined the company in 1900 and ably has upheld the policies and traditions of his father and grandfather. In 1920 the manufacture of gas stoves and ranges was taken up and rapidly expanded to include a wide variety in styles and sizes.

Broaden Safety Work

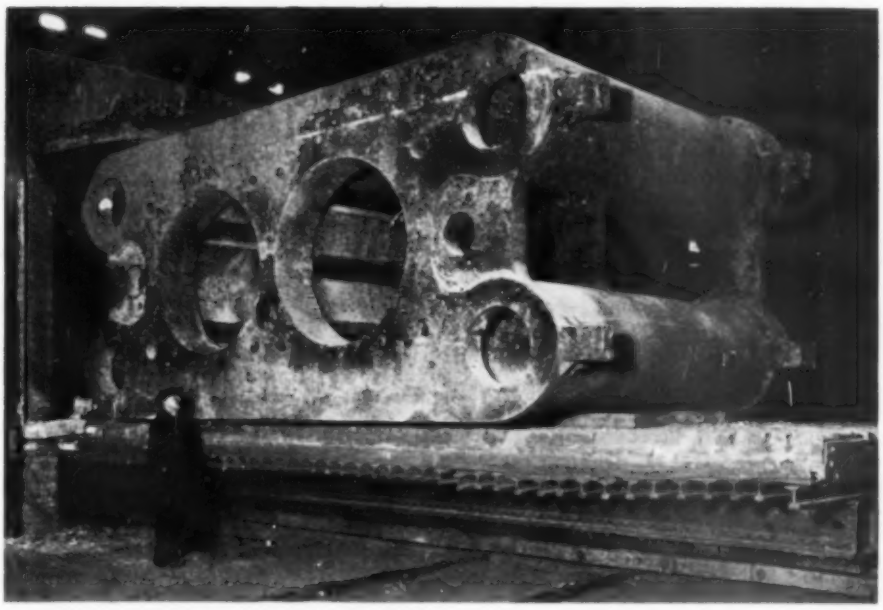
Two representatives of the metal trades were chosen to serve on a new committee which is to bring the heads of some of the best known corporations in the country into active participation in the safety movement.

The new group, to be known as the special advisory committee of the National Safety council, is to be headed by Samuel Insull Jr., Chicago. The metal trades representatives are Frank J. Lanahan, president of the Fort Pitt Malleable Iron Co., Pittsburgh and H. H. Robertson, president of the H. H. Robertson Co., Pittsburgh.

Wright Mfg. Co., a subsidiary of the American Chain Co. Inc., has moved its general sales offices from Bridgeport, Conn., to York, Pa. The company manufactures hoists, trolleys, cranes and electric hoists.

Contraction Allowance Varies with Conditions

By R. A. Bull



Contraction Allowances Must Be Regulated Greatly in Accordance with Design

THE factor of shrinkage or contraction incident to the change of steel from a molten condition at high temperature to a solid form at atmospheric temperature is of tremendous importance in respect to the strains set up in the steel at the various stages. Also it is a factor which regulates dimensional details of the pattern.

Recently our opinion was asked by a large user of steel castings who was preparing data sheets on shrinkage allowance for various metals for the guidance and standardization of practice in his pattern shop. He understood that no such information could be applied without intelligent interpretation. He contemplated allowing for a lateral shrinkage of 3/16-inch per foot for open-hearth carbon and alloy steel and ¼-inch per foot for electric carbon and alloy steel on castings of 1-inch average section thickness. He proposed a radial shrinkage allowance of 3/16-inch per foot for castings between 1 and 3 feet in diameter. He concluded by asking if there is any standardized practice for the amount of material left on steel castings for machine finish.

Provision for Contraction

It is incorrect to figure on shrinkage, laterally or radially, for any kind of open-hearth steel, differing from the shrinkage for the same kind of steel made in the electric furnace; excepting as conditions of metal temperature incidental to the pouring operations justify different shrinkage allowances. To be more specific, given the same pouring temperature and the same approximate chemical composition, we do not believe there is any difference between the shrinkage of open-hearth steel and that of electric or any other kind of steel.

Necessarily, the composition of steel has some influence on shrinkage. But pouring temperature has much more influence. Therefore, with a given design of casting which might or might not be poured with very hot metal, there would be found a higher degree of shrinkage in very hot steel, than in steel poured on what is called "the cold side."

Naturally, design is the predominating factor that regulates pouring temperature. Since the majority of castings made in electric steel foundries have thinner sections than the majority of castings made in open-hearth plants, it may be said truthfully that the amount of shrinkage generally found desirable to allow for electric steel castings is greater than that required for open-hearth steel castings. However, some open-hearth steel foundries produce castings which necessitate highly fluid metal, very hot steel.

Castings with an average thickness of 1-inch, unless large in overall length or width, do not require metal of maximum fluidity, and are readily producible from electric steel or open-hearth steel that is not excessively hot. It is unnecessary to provide differently for shrinkage allowances for such castings, on the basis of the steel making process.

Contraction Figures Vary

It is difficult to prescribe *blanket* shrinkage allowances for steel castings, not only because pouring temperatures vary, but because the contraction allowances must be regulated greatly in accordance with the design. Molds may facilitate or greatly retard the natural contraction of the metal as it solidifies. Given a lengthy casting with no special design features, such as wide flanges at right angles, to obstruct contraction after pouring, the lateral shrinkage of the casting, if poured at the highest temperature sometimes characterizing foundry steel, might be as great as 5/16-inch per foot. Another and different type of casting might be poured in the same heat, but of such a design as to result in a degree of contraction 3/16-inch per foot, or even less. Incidentally, contraction measured ra-

Allow for Shrinkage

THIS paper, slightly abstracted, is from an article by Major R. A. Bull, director of the Electric Steel Founders Research group, which appeared recently in the Research Group News a periodical issued quarterly. Major Bull directs attention to a popular misconception wherein some foundrymen—and others—insist that a greater margin for contraction must be allowed on castings poured from electric furnace steel, than on castings poured from steel made in open-hearth furnaces. Various conditions are responsible for the variation in contraction allowance needed on different patterns and all these conditions must be taken into account, by duly qualified persons, before a definite contraction allowance is assigned to the making of the pattern.

dially might be considerably less in any such case, than contraction measured laterally.

In the ordinary types of more or less lengthy castings as compared with those more nearly cubical or round in general contour, and having sections approximately 1-inch thick, a shrinkage allowance of 3/16-inch to the foot would prove generally satisfactory, either for carbon steel or for simple alloy steel. The amount of carbon exerts a direct influence on the shrinkage. The higher the carbon content, the less shrinkage, other things being equal. This factor of carbon percentage is chiefly reponsible for the fact that contraction in steel is greater than in cast iron.

Cores Have Influence

For radial contraction, ⅛-inch per foot probably would be satisfactory for many castings between 1 and 3 feet in diameter. However, the nature of the core, whether green or dry sand, would influence this feature. A baked core offers more resistance than one which has not been dried.

Regarding the last inquiry relating to machine allowance, the improvements that have taken place during recent years in respect to dimensional accuracy have resulted in reduced allowances for finishing stock. No longer is it necessary to provide such liberal allowances as ¼-inch for many types of castings within the writer's recollection, previously made in large tonnages. On many relatively small castings, ⅛-inch is adequate. Certain designs justify 3/16-inch for finish. Design of casting and nature of pattern equipment have much to do with finish allowance. Machine pattern equipment proper for the production of castings required in large numbers permit the manufacture of the product with the least amount of necessary stock for machining, as compared with wood pattern equipment unmounted or otherwise cheaply made, for the execution of orders calling for relatively few pieces. Incidentally, pattern equipment influences shrinkage allowance, because machine pattern equipment results in molds more nearly exact in all cavity dimensions than molds made from loose wood patterns which have to be rapped manually by the molder to get them out of the sand.

The April and May, 1931, issues of *Machine Design*, contain an article by the present writer, entitled, "Steel Castings as Machine Parts." Information therein might be applied to obtain the most serviceable and econominal product of the steel foundry. Sectional uniformity and member connections are discussed in detail.

So many factors are involved in shrinkage allowance and machine finish; the nature of the casting and the kind of pattern equipment have so much influence on the final results, that it is impossible to lay down definite premises, applicable in a satisfactory way to a great many jobs. Every steel casting, to a large extent, presents a separate problem. It is only through consultation with the foundryman who is to make the castings, that the most satisfactory results may be obtained by the consumer of this material. Despite this handicap of individuality, certain fundamentals, if kept in mind by the user, will benefit him greatly in many details directly related to economy. Application of these governing principles (established by nature, not by foundrymen) can only result, other factors being equal, in a degree of serviceability in excess of what otherwise might be obtained.

Chicago Foundrymen Re-elect Officers

About fifty members of the Chicago Foundrymen's club heard an address by H. J. Rowe, Aluminum Co. of America, Cleveland, at the City club, Chicago, Dec. 3, in a discussion of problems in the production of aluminum castings, as well as inherent properties of aluminum alloys. Mr. Rowe outlined various phases of aluminum castings practice related to the tests and experiments conducted by the foundry development section of his company.

Mr. Rowe outlined factors of advantage and disadvantage in practice with respect to low specific gravity, hot shortness and high crystallization shrinkage. He emphasized that the castings designer often can simplify molding and casting problems. Advantages of casting surfaces for machining in the drag of the mold were illustrated. Mr. Rowe also discussed various types of furnaces for melting aluminum alloys, the effect of heating and pouring temperature on pin-hole porosity, the effects of soaking time and temperature on grain sizes, and the effect of heating and pouring temperature on tensile strength.

Proper sand, emphasizing the importance of 6 to 7 per cent moisture in green sand molding, gating, feeding, the use of fins and ribs to prevent cracking, and other factors were cited. Ramming and its relation to low permeability in both molding and core sand was outlined.

Mr. Rowe showed some interesting slides of new applications of aluminum castings, including a 6-cylinder diesel engine crank case, weighing 2380 pounds; a radial diesel engine crank case of 6-foot diameter; large spandrels in construction work; a large heat-treated aluminum casting base for steam marine engine, weighing 4000 pounds; a transformer blower base for an electric locomotive, 7 feet long; and underframes for dining and sleeping cars being made for the Pullman Co., Chicago.

The Chicago club re-elected all officers for the ensuing year. These are: President, L. E. Gilmore, Crane Co., Chicago; vice president, R. E. Kennedy, technical secretary of the American Foundrymen's association, Chicago; and secretary-treasurer, Albert N. Wallin, S. Obermayer Co., Chicago.

Materials Handling Institute Formed

Representatives of 62 companies engaged in the manufacture of materials handling equipment and accessories, met Tuesday, Dec. 8, at the Hollenden hotel, Cleveland, and established the Materials Handling institute.

The following officers were elected: President, Frank E. Moore, president, Mathews Conveyor Co., Elwood City, Pa.; vice president, J. B. Webb, president, J. B. Webb Co., Detroit; treasurer, H. W. Standart, Northern Engineering Works, Detroit, and secretary, John A. Cronin, editor, *Materials Handling and Distribution*, New York.

The meeting elected a board of 11 governors representing groups within the industry as follows: H. W. Standart, hoist and crane group; F. E. Moore, gravity conveyors; J. B. Webb, continuous conveyors; J. F. Thomas, Nutting Truck Co., Faribault, Minn., floor trucks and casters; Brinton Welser, Chain Belt Co., Milwaukee, portable and bulk conveyors; E. F. Twyman, Barret-Cravens Co., Chicago, lift trucks and portable elevators; S. W. Gibb, Yale & Towne Mfg. Co., Philadelphia, industrial trucks and tractors; William E. Bee, Palmer-Bee Co., Detroit, transmission; H. H. Perry, Geo. D. Whitcomb Co., crawler cranes and locomotives; A. F. Anjeskey, Cleveland Tramrail division, Cleveland Crane & Engineering Co., Wickliffe, O., tramrails; and Richard Straw, American Kron Scale Co., accessories.

St. Louis Group Meets

T. P. Halley, Southwestern Bell Telephone Co., St. Louis, addressed the regular monthly meeting of the St. Louis Foundrymen's association on Tuesday evening, Nov. 24, at the American Annex hotel. Mr. Halley spoke on "Today Talking to Tomorrow." Walter C. Raithel, Century Electric Co., St. Louis, and president of the association, presided.

Production of malleable castings in October totaled 20,123 tons compared with 18,193 tons in September and 28,785 tons in October, 1930. Orders booked reached 18,145 tons against 17,610 tons in September.

BILL

By Pat Dwyer

Learns of Facing Molds Abroad

BILL came in the other night to find me engaged in the peaceful occupation of reading a recent copy of the old home paper. As a plain matter of fact I have spent many more years elsewhere—the proportion is better than three to one—than I spent in the town of my youth where among other things I learned to be "A molder and a caster." However, for some obscure reason which I intend to investigate some day when I have the time and the inclination—a rare combination—I still regard the old town as home and the people in it as neighbors. Most of the people who figure in the news columns are strangers to me, but occasionally I recognize a name and usually that is sufficient to promote a reminiscent half hour with Bill.

In this particular instance I read an item in the society column to the effect that Mr. A. Algernon Laurie of 320 Hawthorn street had accepted an important and highly lucrative position with a wholesale firm in Montreal and would depart for the scene of his future endeavor the first of the week.

"A. Algernon, hey?" Bill remarked, "That must be a son of Angus Laurie who ran a grate bar side floor down near the end of the shop. Remember him? Seems to me he built a house on Hawthorn street, out on the edge of the town a year or two after you and I flew away to seek our fortune. Now he has a son old enough to part his name in the middle, suppress the Angus half of it and feel shame for an honest old father whose only fault was an incurable pessimism."

"You may be doing the young man a grave injustice," Dash it all I could not stand by and hear any member, even the second generation of the old town traduced in such a scaly manner. "A split name is better than a split infinitive and besides the name probably was wished on him by his mother. If she was that kind of a woman I can understand the pessimism of Angus Sr., and the desire of Angus Jr., to leave home."

"Without even going through the usual formality of closing my eyes," Bill said, "I can call up a vision of the foundry stove and the gang sitting around it at the noon hour. Irrespective of the subject—and you know what a wide range of topics may be covered at one of these meetings—Angus was sure to bring in some pessimistic reference. One of his favorite references was to any person who happened to be sick. Every person knew every person in those days. Angus invariably wound up his comment with the prediction

How His Little Heart Beat as He Popped the All Important Question

that the afflicted person would depart 'With the falling of the leaves.'

"He managed to impart such an eerie, ghoulish, desolate, graveyard-at-midnight cadence to this phrase that I shivered on the first few occasions I heard it. In time, of course, I grew accustomed to it and shivered no longer, particularly when I observed through experience that almost invariably he was mistaken in his prophecy."

"You don't hold with this theory that lingering deaths coincide with the falling of the leaves?"

"No," said Bill, "Nor with the going out of the tide, the dying of the storm, the coming of the dawn, or any other of the faithful old standbys of poets, novelists and sob sisters on the daily press. These birds almost without exception suffer from a narrow perspective which only includes a square mile or two of territory in their immediate vicinity.

"According to reliable statistics available in published form to any person who wishes to consult them, approximately 100,000 people die every day and 150,000 tenants arrive on the earth in the same period of time. While on this subject and before the figures slip from my mind you may be interested to learn that at the present rate of progress, a net gain of 50,000 a day births over deaths, the population of the world will double in about 600 years. There is something to worry about!

"However, what I wanted to point out is the utter nonsense of claiming that the majority of deaths take place at any given periods. The process is going on continuously and the old saying 'A death and a birth with every tick of the clock' is much nearer the truth than the claim of any connection of these events with the rotation of the seasons or the ebb and flow of the ocean tides. That old tick of the clock is a conveniently handy term, ranging as it does from the dignified 2-second interval between ticks of the stately old grandfather clock to the 2-per-second tick of the little toy on the chimney piece. If you have the time and the patience you can figure it out for yourself on a basis of 86,400 seconds in a 24-hour day. If you don't want to do that, listen while I read you some dope on the difference between English and American steel foundry facing.

"I had a letter recently from an English foundryman in which he said he was greatly interested in a recent issue of THE FOUNDRY containing a description of the methods employed in producing a 300-ton steel casting. Description of the patternmaking, molding, coremaking and drying was excellent—he wrote—but he should like to know what kind of refractories were used in the mold and cores. Was the mold hot or cold immediately before the metal was poured into it? In England a refractory facing known as *compo* is prepared from a mixture of old crucibles, fire brick, hard coke, ganister and silica. The face of the mold is covered with a carbon blacking mixed with China clay wash and later when the mold comes out of the oven and still is hot, the face is covered with a coating of tar or pitch. According to his experience, proper drying is one of the most important features in mold and coremaking. Also he has found that the casting poured in a hot mold peels better than a similar casting poured in a cold mold. He noted that after the cores were placed in the mold, the hollow interiors were filled with coke and black sand. He is interested to learn if this stopped infiltration of the metal. In a 90-

ton semisteel block he has seen 10 and 12-inch cores almost impossible to remove on account of filtration.

"I wrote him that all the steel castings in American foundries are made in sand molds. This includes green sand, dry sand and loam. In certain sections of the East a naturally bonded high silica sand is

Sees All, Knows All and Tells Nothing!

available, but in all other sections a synthetic sand is employed. It is made up of an almost pure silica sand—the silica content usually is 98-99 per cent—bonded with sufficient clay to render the mass workable as molding sand. Naturally the amount varies depending on the amount of used sand incorporated in the mixture, but all effort is directed to holding the clay content to a minimum. The mixture is prepared in a roller and pan type mill operated according to one of two principles. In one the rollers revolve while the pan remains stationary. In the other the pan revolves while the revolving rollers remain in a fixed position. Green sand facing for light castings requires the addition of only small quantities of new sand. Dry sand facing for large castings is made up entirely of new silica sand bonded with clay and in some instances a small quantity of core binder. Suitable mixtures for all sizes of castings in between are made by varying the relative amounts of new and old sand. The consumption of new sand in American steel foundries is approximately one ton per ton of castings shipped. Large cores are faced with the same material employed for facing the mold.

"The illustrations accompanying the article show that the sand peeled clean from the outside and the inside of the casting. This was to be expected on the outside where the metal shrunk away from the face of the mold. Removal of the cores was greatly facilitated by providing great cavities in the interior of the cores. These cavities were filled with loose coke and covered with floor sand to prevent metal from flowing in over the top or through the joints. The filling did not prevent the cores from yielding under the pressure of the cooling metal. In this manner the sand was not subjected and held under immense pressure while at a high temperature and consequently was not transformed into a solid, hard, inpenetrable mass, something blamed on filtration of metal.

"I quite agree that proper drying is one of the most important features of mold and core making, but I cannot say that I have found any marked difference between a casting poured in a hot mold and one poured in a cold mold, provided, of course, that both are perfectly dry. The mold under discussion was cold by the time it was assembled, weighted and made ready for the metal.

"As an extreme instance I might refer to a certain memorable occasion when a number of molds for steel castings were allowed to stand for several weeks, part time in zero weather, and afterward poured without any preparation other than inspection of gates and risers.

"On account of the great affinity of steel for carbon I am at a loss to understand why he should apply carbon blacking to the face of molds for steel castings. American foundrymen apply a silica wash to dry sand molds. Green sand mold faces are untreated. To secure further light on this and other points raised in the letter I wrote to a prominent foundryman who has had extended experience in steel foundries on both sides of the Atlantic. He very graciously responded as follows:

Compo still is used both in England and Germany for heavy castings. The English variety is a mixture of crushed old crucibles, hand picked bricks, and highly siliceous rock, bonded with a high quality clay. The German facing doubtless was compounded similarly at one time, but in recent years a compound known I believe as *chamotte* has been developed of sintered aluminum silicate bonded with clay. In both cases the grading of the material is very important to insure the freest possible venting.

After the pattern is withdrawn, the face of the mold, which is very open, is painted thickly with a mixture made from the best old crucibles, silica flour and china clay, all milled to the condition of a fine flour. A ball mill is used for the purpose and it is not possible to get the product too fine.

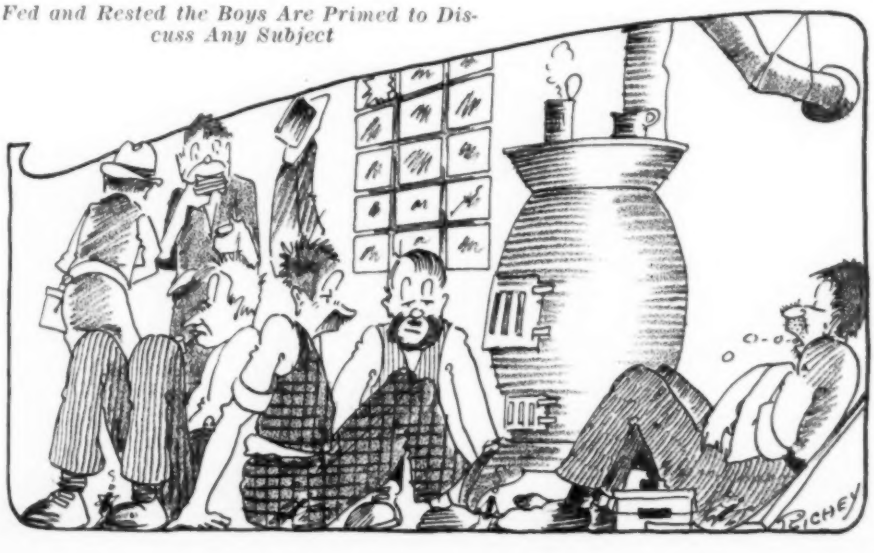
Compo molds stand a very high baking temperature, but practice after baking is a matter of individual opinion. Many large molds are tarred while hot. In other instances only a spray of silica paint is applied to the hot molds. Practice varies to a considerable extent and "One man's meat is distinctly another man's poison."

As an example, we did not permit sleeking of the compo mold, but insisted on sleeking only after the paint was applied. In my opinion this kept the compo face open right up to the paint and resulted in improved castings.

My opinion on the relative values of compo and a straight sand mixture is slightly indeterminate, but the following comparisons indicate my opinion in a general way. Good compo strips beautifully and leaves an almost perfect skin. However, it is expensive both to produce and ram and renovation is impracticable. Compo stands up better to erosion than anything else I have seen. Cylinder castings 17 to 20 feet in length, 7½ inches inside diameter, regularly are gated on top, and yet strip perfectly their full length.

Tarring in most cast cases is an unnecessary elaboration if the paint is right, but for certain very heavy jobs seems to effect an improvement. However, it must be applied in a manner to insure the complete burning out of volatiles, or trouble is certain. From the standpoint of material cost and labor in mold preparation, sand is better. I prefer to continue its use and endeavor to overcome its susceptibility to washing and burning in, rather than attempt the introduction of compo in any American steel foundry.

Fed and Rested the Boys Are Primed to Discuss Any Subject



Even the Customer Prefers To Buy by the Piece

By E. W. Johnston

BUYING castings by the piece instead of by the pound has come upon the economic world so rapidly that it can almost be classified as a revolutionary idea. Piece-price purchasing in itself is not new, but its application to the purchase of castings on a large scale is a recent development.

We manufacture a line of excavating and materials-handling equipment, whose weights vary from 45,000 to 120,000 pounds each. Production volume, while high for that type of product, would seem relatively small in numbers to the average production man. Types of materials used are most diverse, with a large percentage of the total bulk in cast shapes. These run into tons of iron, steel, bronze and malleable castings, varying in size from small castings to large ones weighing 4000 to 6000 pounds each.

Buy by the Piece

Under our old methods all had to be received, checked and distributed upon arrival at our plant. Our receiving problem began to annoy us. The usual cracking-down failed to produce customary results. We could not understand it, and finally went after information that might result in a variation in the receiving-room routine. For some time we tussled with the problem. Finally the suggestion was made that we buy castings by the piece. Thus the receiving-room job would be a simple one of counting, rather than of handling and weighing.

With this idea we approached the foundries. We found we were within the realm of good judgment. In certain other instances foundries were selling on a per-piece basis. However, they still were using the per pound basis as the backbone of their price lists.

Nevertheless, we persisted and are now buying castings on a per-piece basis, cast within maximum and minimum weight limits. The real result we achieve from the new policy was much greater than the mere solution of receiving-room problems. We have found the most satisfactory solution of how to buy castings efficiently, both from our standpoint and from that of the foundry.

Such a plan must be advanced, at least at present, by the purchaser, because foundries are well bound to the traditional per-pound basis. This is only natural when you consider that the foundry buys pig, scrap, fluxes, sand and other ingredients that go into its products on a per-pound basis. Its inventories are kept that way; its mixes are made that way; and even the common carrier accepts castings on a per-pound basis.

The modern trend in selling is toward unit prices—a per-piece basis—and there is no reason why the steel, iron, malleable, brass and bronze casting manufacturers should not transpose from cost per pound and labor by the hour into a per-piece unit cost, particularly in view of the following advantages:

1. The purchaser knows definitely what his price is to be. If the casting is underweight, his inspector will reject it. The foundry will take care to prevent overweight.

2. Burden of weighing the pieces falls primarily upon the shipper, who must weigh them for railroad acceptance. By buying f.o.b. destination, a further control may be placed on the foundry to remove all excess sand and metal.

3. Tendency of the foundry is to save metal instead of, as at present, to rap the pattern hard to put on extra metal and build up the cost. The foundry, in its desire to save metal, will adhere more closely to specifications, will remove excess metal, and will hold to more exact finishes.

4. In certain cases it costs more to buy castings on a per-piece basis than it does on a per-pound basis. This is because the particular casting is hard to make. A manufacturer purchasing on a per-pound basis seldom is approached by the foundry to redesign his product, as the only way the foundry can profit from such a redesign is to make it heavier, which is of little benefit to the purchaser. If, however, castings are bought on a per-piece basis, new patterns can be of mutual benefit.

5. In doing this a purchaser may be doing himself a still greater favor, for castings that are hard to make are invariably hard to machine, and often the redesign can save much in machining costs.

6. The purchaser can buy more in keeping with his selling price. On items where production is big he can buy more economically; on items he buys singly or in small quantities he pays more, just as he sells his own big production items on a lower cost basis than special ones.

Weigh First Casting

As production manager of the Thew Shovel Co., I act as general manager as well for a small gray iron foundry. I can say truthfully that I would like nothing better than to sell our output on a modern per-piece basis. I would like to make one point clear from the foundryman's side—the first casting made should be made on a per-pound basis to determine accurately an average weight, and the *workability* of the design as applied to foundry practice.

The Buyer Benefits

AGITATION for adoption of the principle of selling castings by the piece rather than by the pound has been emphasized repeatedly by THE FOUNDRY *during the past ten years. Both individuals and groups within the foundry industry have agreed on the importance of the policy in solving one problem of distribution.*

An angle, which promises to speed the adoption of the piece price policy, is introduced in this article. The author, who is production manager,, the Thew Shovel Co., Lorain, O., points to the benefits his company has secured in purchasing castings by the piece when the finished article, in which are castings are used, also is sold in the same manner. As a buyer of castings, he now demands adherence to the piece price plan in all of his purchases.

This abstract is from an article which appears in the October issue of Factory and Industrial Management.

Records may be available to supply this information, but where a new casting s being purchased such a plan will bring seller and purchaser more quickly to mutual satisfaction.

Cleveland Gray Iron Group Meets

Charles E. Mitchell, associate manager and cost accountant for the Gray Iron institute, and W. W. Kerlin, institute metallurgist, were speakers Nov. 24 at a local group meeting of Cleveland foundrymen at the Hotel Cleveland. Mr. Mitchell outlined the cost accounting plans for future institute activities while Mr. Kerlin discussed "Merchandising Castings Through Technical Data." A. C. Denison, Fulton Foundry & Machine Co., Cleveland, chairman of the Northeastern chapter, presided. Plans for other meetings to be held in various parts of the country within the next few months are under way, according to Arthur J. Tuscany, manager.

Consider Stabilization of Employment

A recent bulletin issued by Granville P. Rogers, managing director, Steel Founders' Society of America, New York, points out that many steel foundries have made a determined effort to retain as many of their employes as possible, in keeping with the suggestions made by the committee on employment plans and suggestions of the President's Organization on Unemployment Relief. The bulletin also states that ways and means of spreading available work, basis of analysis of payroll for lay-off purposes, methods of assisting workers laid off and permanent policies for stabilizing earnings and employment, as worked out by some who have studied the factors carefully, should be helpful to steel foundries in laying plans for handling the situation.

The following outline, containing some factors to be considered in adopting a definite policy, is presented by the Steel Founders society for the guidance of executives faced with these problems:

Methods of spreading employment: Reduced weekly schedule; reduced daily schedule; shorter shifts in continuous operation; alternating shifts, gangs or individuals on same job (staggering).

Methods of increasing work available: More extensive maintenance and repairs; accelerated replacement; construction; production for stock; development of new products and new customers.

Analysis of pay roll and survey of personnel as a basis for lay-off procedure: Disclosure of persons willing to go on furlough without pay; disclosure of duplication of wage earners in the same family unit in the company's employ; determination of need for earnings as indicated by number of dependents and home responsibilities; determination of adequacy of part time earnings; determination of practicality of predating transfer to pension roll; indication of persons to whom asurances can be given safely as to security of their employment; maintenance of list for preferential employment.

Methods of assisting persons laid off: Placement in other jobs, whether temporarily or permanently laid off; loans and credits; dismissal compensation in case of permanent lay off; follow up surveys through personal visits, card records and community interchange of information; co-operation with community relief agencies.

Permanent politics for stabilization of earnings and employment: Forecasting and planning; broader training of new employes, apprentices and special groups within personnel; guaranteed employment; the elastic workday or week; unemployment insurance.

Show Profit by Pushing Sales And Advertising Efforts

IN RESPONSE to many demands for definite information, the bureau of foreign and domestic commerce of the department of commerce, late in the summer of 1931, undertook the collection of instances of business and industrial firms which have made material progress during the depression in maintaining or increasing sales volume or profit. Information also was secured on the policies or reasons for such progress, in the belief that the focusing of attention on sound and successful policies would help direct business into constructive lines.

Three hundred and fifty-eight examples were gathered from various district offices and commodity divisions of the bureau and from business publications. These represent 202 manufacturing industries, 43 retail distributors and ten wholesalers. They represent 74 cities in 30 states. In summarizing the results of the survey, the bureau has excluded many examples where the success of the company was not due to its own efforts but to a favorable demand caused by outside agencies, such as governmental stimulation of public improvements.

The study shows that increased sales effort and advertising policies are the most important reasons given by firms for their success. Market research, reduced prices, co-operation with dealers, improvement of service and management of salesmen occupy a prominent position in the marketing program of companies. Of scarcely less importance are the policies dealing with new products, quality, research, diversification and modification. In their production policies, firms have focused most of their attention on the reduction of operating expenses and the installation of modern equipment.

It is noteworthy that not one of the concerns included in the study as having been successful in combating the effects of the depression, has diminished its sales effort to save money. In many cases, sales costs and increased sales efficiency have been studied more closely, but the drive for sales volume has not been lessened. More firms, 80 in all, made statements concerning their advertising policies than on any other single topic, indicating the importance attached to the value of advertising by the successful companies.

Ten firms stated that more thought was given to the training and direction of their salesmen, providing them with more information regarding sales possibilities. To effect greater economy and efficiency in selling, five concerns studied their markets more closely and made adjustments in their territory. Seventeen concerns and trades found that careful study of their markets was effective in increasing sales and disclosing inefficiencies in marketing. Eighteen companies reported that they reduced prices of their products and 14 improved the quality of the product to keep prices at practically the same standard. Fourteen concerns have followed a definite policy of modernization of machinery and equipment to reduce operating costs and increase factory efficiency.

Among a number of examples cited by the bureau, several are of direct or indirect interest to the foundry industry. A company manufacturing an automatic stoking device made money in 1930 by redoubling its sales efforts, increasing its distribution efficiency, providing a more direct advertising appeal and stressing the money saving character of the product.

A 34 per cent increase in profit for the first six months of 1931 is the successful record of a company manufacturing piston rings. This was accomplished through the application of several factors including an increased appropriation for advertising, the development of a new and more efficient ring, the use of talking picture outfits by salesmen and the reduction of manufacturing costs through better equipment and efficient management.

The FOUNDRY Family Photograph Album

Upper Left

PROF.
R. S. McCAFFERY
University of Wisconsin
Madison, Wis.

Upper Right

J. E. McCAULEY
Birdsboro Steel Foundry & Machine Co.
Birdsboro, Pa.

Lower Left

SAM TOUR
Lucius Pitkin, Inc.,
New York

Lower Right

A. S. COULTER
Werner G. Smith Co.,
Cleveland

DAN M. AVEY
Editor

The Shakeout

FRANK G. STEINEBACH
Managing Editor

PAT DWYER
Engineering Editor

EDWIN BREMER
Metallurgical Editor

CHARLES VICKERS
Nonferrous Editor

NORMAN F. HINDLE
Assistant Editor

¶ Weak Sisters' Sins

IN GENERAL in those states which have enacted workmen's compensation laws, the basic rates for insurance in the foundry industry are increasing. The increase is due to several reasons which are outlined by one state industrial commission as: Increased benefits by amendment to the law; increasing medical cost trends; increasing liberality in the interpretation of the law by the courts on appealed cases previously disallowed by the commission; decreasing wage levels resulting in lower payroll and premium without corresponding reduction in claim cost, and increasing burden on the fund due to employers of three or more employes failing to comply with the act by payment of premium and the fund being required to pay claims of injured employes and dependents of killed employes, and the inability to recoup the fund from such employers due to insolvency and other causes.

WHILE those factors undoubtedly have much to do with the increase in the insurance rates, the real root lies in the increase of the number of accidents, and to obtain any worthwhile decrease in insurance rates, the accidents must be reduced stringently. Practically all of the state industrial commissions have promoted laws requiring the employers to provide various safeguards for the employes, and while these are on hand to comply with the regulations many employers are lax in enforcing their use. Consequently, accidents happen as may be expected under the conditions.

FOR example regulations in the foundry industry usually specify the use of fireproof leggings, goggles and protective shoes during pouring. The first two are supplied by the employer, but the latter is up to the employes. In many instances the men avoid wearing the leggings and goggles provided, and will not wear the proper type of shoes. The management begs the question, and through that attitude becomes a party to violation of the regulations. The burden of the cost of accidents happening through such conditions to a slight extent is placed where it belongs, but unfortunately the more careful employers also must bear a part of the burden. Apparently, the only method to correct the many unobservances of the industrial regulations is to fine heavily those employers who fail to make their employes use the safeguards mentioned in the regulations.

¶ Do Unto Others

ALTHOUGH forgotten, ignored, over looked and in many instances deliberately pushed out of sight, the justice of the Golden Rule, "Do unto others, even as you would have others do unto you" never has been, never is and probably never will be questioned by even the most daring member of that great majority which consistently denies in act what it believes in mind. So long as men are willing in an actual show down, to admit that the golden rule is desirable and workable, a chance remains to stage a working revival.

WHAT better time than the present, the new year with its association of new resolutions, what better time could be selected for giving the golden rule a little tryout in a field from which it has been squeezed by the hard boiled attitude assumed by some leaders of industry and their representatives when selecting employes for more or less responsible posts in the organization. An advertisement is placed in a magazine which circulates in the particular field. Several men see it and apply for the position. One man is notified to report for an interview or for duty, but the others are not even given the assurance that their applications have been received.

THE objection may be raised that a refusal is a refusal whether the impression is conveyed by utter silence or by a flood of many words, but so long as human nature is what it is, the one refused will accept his disappointment in a more cheerful spirit if he is assured that his application received consideration. Usage and custom sanction the present method of "Tellin' 'em nothin'," but usage and custom have been changed in the past and there is no reason why they cannot be changed in the future. Little acts of courtesy never yet detracted from a man's reputation, from his bank account or from the innate sense of justice which prompts every right thinking man—despite occasional bits of evidence to the contrary, they still are in the majority—to do unto others even as he would have others do unto him.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

CARL H. HOFFSTETTER, recently elected vice president of the National Founders association, was born in Kalamazoo, Mich., Jan. 2, 1875, and was educated in the public schools of Kalamazoo and Erie, Pa. In 1896 he organized the Odin Stove Mfg. Co. and in 1900 the firm was reorganized and incorporated. A foundry was built and began operations in connection with the company in 1905 and in 1930 that part of the company was moved into new quarters equipped with the most modern foundry equipment. Mr. Hoffstetter is president and general manager, Odin Stove Mfg. Co., and president, Erie Foundrymen's association.

Col. Albert T. Perkins has been elected chairman of the board, Fulton Iron Works, St. Louis.

H. M. Nystrom recently returned to the open-hearth department of the Falk Corp., Milwaukee, after a four months' leave of absence spent in California.

Thomas S. Hammond, chairman of the board of Whiting Corp., Harvey, Ill., has been nominated for first vice president of the Illinois Manufacturers' association for 1932.

Samuel Smith, formerly connected with the Halloran Brass Foundry, Astoria, Long Island, N. Y., now is employed as foreman of the Nassau Brass Foundry, Freeman and West streets, Brooklyn.

Cary Wright has been appointed manager, Ideal Furnace Co., Milan, Mich., succeeding Everett Betts, resigned. Mr. Wright formerly was connected with the United States Radiator Corp.

Vaughn Reid, City Pattern Works, Detroit, was a speaker at the regular meeting of the Quad-City Foundrymen's association held Monday, Nov. 16, at the LeClaire hotel, Moline, Ill. Mr. Reid spoke on "Patterns."

George E. Madden, formerly identified with the Industrial Silica Corp. at Pittsburgh has joined the sales department of the Duquesne Steel Foundry Co. and Wheeling Mould & Foundry Co. with offices in the Grant building, Pittsburgh.

H. Bornstein, Deere & Co., Moline, Ill., will be the speaker at the Dec. 21 meeting of the Quad-City Foundrymen's association at the Fort Armstrong hotel, Rock Island, Ill. Mr. Bornstein will speak on "Feeding Castings."

Rufus L. Patterson, president, American Machine & Foundry Co., New York, is the co-donor with John M. Moorehead, American minister to Sweden, of a bell tower, valued at $100,000, recently presented to the University of North Carilona, Chapel Hill, N. C.

Anthony H. Kramer, recently reelected president of the Ohio Foundries association, is president, Advance Foundry Co., Dayton, O. Mr. Kramer started his foundry career as a molder. For several years he was superintendent of the Bryan Foundry Co., Indianapolis, and when the Advance Foundry Co. was organized at Dayton in 1904 he became connected with that organization. In 1910 he was made president of the company. Mr. Kramer served as the employers representative on the committee appointed to revise the Ohio Foundry code, and which has been in operation since May 1, 1931. He also has been instrumental in the furthering of safety work and under his leadership, the Ohio Foundries association has undertaken a safety campaign to reduce foundry accidents and secure a lower state insurance rate.

Anthony H. Kramer

O. C. Kahler, formerly general superintendent, J. G. Brill Co., Philadelphia, recently has been placed in charge of sales in eastern Pennsylvania for the Meadville Malleable Iron Co., Meadville, Pa., with offices at 1018 Girard Trust building, Broad street and South Penn square, Philadelphia.

Ing. Comm. Carlo Vanzetti, the leading Italian foundryman who was responsible for the success of the international foundry congress held in Milano in September, has been honored by the King of Italy, who has conferred upon him the decoration of Cavaliero Al Merito del Lavoro, an order for work of outstanding merit.

Tillman D. Lynch, manager of the materials and process engineering department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has resigned, and plans to engage in the business of consultant on materials and design in Pittsburgh. Mr. Lynch was president of the American Society for Steel Treating in 1923, and was also a former president of the American Society for Testing Materials.

Earl T. McKinney has accepted a position as patternmaker with the Atlas Foundry, Charlotte, N. C. Mr. McKinney served his apprenticeship in the pattern department of the Missouri Pacific railroad at Sedalia, Mo. In 1929 he was employed by the General Steel Castings Corp., Granite City, Ill., and since that time has been connected with the Western Land Roller Co., Hastings, Nebr., and the Ferguson Pattern Works, Kansas City, Kan.

William M. Berent has resigned his position with the Flint Foundry Co., Flint, Mich., to take over the agency of the Pioneer Gasoline Co. for the Akron and Lockport, N. Y., districts with headquarters at 37 Clinton street, Akron, N. Y. Mr. Berent began his foundry career as a patternmaker, working in various foundries in and around Buffalo. He then served for one and one-half years in the foundry in the Gould Coupler Co., Depew, N. Y. On March 1, 1919, he became connected with the Flint Foundry Co. and in 1927 he was transferred to the Marshall, Mich., plant of the Flint Co.

Sees Increase in World Metal Consumption

Boom times for the ferrous and nonferrous industries, when in the distant future per capita consumption of the world attains the present rate in the United States, was forecast by Dr. Zay Jeffries, consulting metallurgical engineer, Cleveland, in an address on the romances of metals and alloys, a feature of the three-day conference on metals and alloys held at Case School of Applied Science, Cleveland, Nov. 18-20, and sponsored jointly by the school and the Cleveland Engineering society.

Assuming these conditions, Dr. Jeffries stated that production seven times as large as the present would

be required to satisfy demand. Exhaustion of available supplies of certain nonferrous metals, including copper, he said, probably will make necessary development of other alloys.

A new era in civilization, the age of alloys, was signalized by various speakers. Applications for metals, requiring increased strength, toughness, resistance to corrosion of all types and pleasing appearance, are opening new fields for research.

Alloys of nickel, copper, aluminum, magnesium, zinc and steel were discussed by investigators active in these fields. Included in more recent developments is a new series of magnesium alloys, which, according to L. B. Grant, Dow Chemical Co., Midland, Mich., are receiving considerable attention due to reductions in the cost of their preparation. These light alloys possess high strength and it is claimed that builders of automobiles and airplanes are contemplating their adoption for certain parts.

Orders Increase

Gray iron foundries showed a slight decrease in production during October, but reported a small increase in the percentage of new business and unfilled orders, according to a report compiled by the Gray Iron institute. Production dropped from 49.4 per cent of normal in September to 47.6 in October. New business increased from 37.9 to 39.6 while unfilled orders increased from 29.4 to 29.7. Last year, all three showed a decline during October. Three of the 126 reporting foundries view the business outlook as good, 37 fair, 49 poor and 37 bad.

Increased activities during October were reported in the Ohio, Pennsylvania, Michigan and Indiana district from 46.4 in September to 49.3. The New England and Canadian foundries operated at the September level of 44.3 per cent, while the rest of the country reported decreased activity.

Discuss Group Costs

Charles A. Klaus, cost consultant of the Newark cost group and the Gray Iron institute and Henry Sokolsky, B. F. Sturtevant Co., Boston, were speakers at a meeting of the New Jersey Foundrymen's association held at the Downtown club, Newark, N. J., Wednesday, Dec. 2. Mr. Klaus discussed "Actual Experiences in Cost Group Work" and Mr. Sokolsky spoke on "Possibilities of Wage Incentives in the Foundry." W. H. Mantz, president of the group, presided.

Construction contracts awarded during October amounted to $242,094,200, according to a report of F. W. Dodge Corp. The total represents a slight decrease over the previous month.

Robert G. Crawford Dies

Robert G. Crawford, 58, president and general manager of the Atlas Foundry Co., Detroit, died at Grace hospital, that city, Sunday afternoon, Nov. 22, from pneumonia following an operation. Of an exceptionally sanguine and enthusiastic temperament and through active participation in all their activities, he was one of the best known foundrymen in local and in the national organization. Mr. Crawford was born in Glasgow, Scotland and at an early age commenced

Robert G. Crawford

serving a seven-year apprenticeship at the molding trade. Part of this term was served at the Hyde Park foundry and part at the Plantation foundry. In 1902 he arrived in Milwaukee and remained three years. From 1905 to 1908 he worked at his trade in New York, New Jersey and Pennsylvania. In the latter year he accepted a foreman's position with the Detroit Foundry Co., and the following year accepted a similar position with the Murphy Iron Works. A gold watch with a eulogistic inscription was presented to him when he left in 1910 to accept a position of foreman with the newly organized Atlas Foundry Co. A year later he was promoted to the position of superintendent and in 1913 in recognition of specially meritorious service he was elected president and general manager, a position which he filled continuously up to the time of his death. A skilled foundryman he was in position to keep in close and intimate contact with all phases of his business.

As president of the Detroit Foundrymens' association he served as chairman of the local executive committee in charge of entertainment at the International Foundry Congress held in Detroit, Sept. 27-Oct. 1, 1926. In 1929 he was one of the party of American foundrymen who attended the international foundry congress in London and later toured the British isles and part of the continent, accompanied by his wife and daughter.

For many years he has been interested in the technical training of young men for the foundry industry and has kept in close touch with the subject as handled by the University of Michigan, Ann Arbor, Mich., from which his oldest son, Robert Jr., was graduated in 1924. In addition to Robert, who has been assistant to his father for several years, Mr. Crawford is survived by Mrs. Sarah Crawford, a daughter, Mrs. Kenneth Garrett, and two other sons, William and Arthur, all of Detroit.

Describes Egan Plan

"The Egan Plan" is the subject of a 24-page booklet recently issued by the American Cast Iron Pipe Co., Birmingham, Ala., as a handy source of information for the increasing number of business, educational and sociological students seeking information on that subject. Briefly, the Egan plan involves a trust ownership of the entire voting stock of the American Cast Iron Pipe Co. in the interest of the company's employes, managers and customers. All money available for dividends on this stock is distributed, in the discretion of the trustees, to the individual or collective benefit of the employes. These expenditures are considered a part of the cost of operation and, in that light, and within that limit, the company's products are delivered to customers at actual cost.

The booklet points out that the American Cast Iron Pipe Co. believes the plan, after ten years of application, has proven its practicability and worth, not only in improving living and working conditions obtained for the company's employes, but also in the success of the company as a business factor. It is felt that the plan has worked economically as well as socially.

Study Pyrometer Tubes

Certain types of thermocouples are highly sensitive to changes in the composition of the wires composing them, and they must be protected from contaminating gases and vapors. The protecting tubes used are porcelain, fused silica or metal, and the results of tests of the resistance to the passage of gas through the walls of a number of those tubes is presented in research paper No. 354 of the bureau of standards, Washington. The paper, "The Passage of Gas Through the Walls of Pyrometer Protection Tubes at High Temperatures," by W. F. Roeser, and may be obtained from the superintendent of documents, Washington, for 5 cents.

OBITUARY

Leon Thomas, past president of the Association Technique de Fonderie de Paris and consulting engineer on foundry practice, died recently. Mr. Thomas was born on July 27, 1878, and studied at the Ecole des Arts et Metiers, Chalons, from 1894 to 1897. He worked as a molder from 1898 to 1901 in France, Switzerland and Germany. In 1902 he was chemist at the Forges de Trignac, Saint-Nazaire. From 1903

Leon Thomas

to 1910 Mr. Thomas was connected with the Usines Piat Soissons, gear manufacturer, where he was supervisor and later assistant manager and then manager. In 1924 he became manager of the foundry of the Citroen Works, Paris. Mr. Thomas was one of the founders of the French association and was its president in 1928 and 1929. He also was vice president of the Society of Old Fellows of the Ecoles Nationales d'Arts et Metiers and Chevalier of the Legion of Honour.

Joseph White, 81, pioneer brass foundry operator at Lima, O., died recently. Mr. White established the White Brass Foundry at Lima 50 years ago and remained president and general manager until his death.

James H. Caldwell, 66, chairman of the board, Ludlow Valve Mfg. Co., Troy, N. Y., died Nov. 18. Mr. Caldwell, an engineer, was a native of Mobile, Ala., and a graduate of the Rensselaer Polytechnic Institute in 1886. He was a vice president and a trustee of the institute.

Henry A. Pridmore, 48, identified for more than 30 years with the foundry supply industry, died Nov. 26, at his home in Oak Park, Ill. For some time Mr. Pridmore was associated with his father, the late Henry E. Pridmore, who founded the Henry E. Pridmore Co., manufacturers of molding machines and foundry supplies. He remained with that company until it discontinued business in 1927. Since then he has been connected with the International Harvester Co., Chicago. His brother, Edward A. Pridmore, is president of the International Molding Machine Co., Chicago.

James Arthur Limerick, internationally famed for the statuary and other artistic bronzes cast in his foundry, 960 North Howard street, Baltimore, over a period of many years, died suddenly in his home in that city Nov. 21, at the age of 61. He was born in Philadelphia July 19, 1870, and after a formal education, studied at the Philadelphia Academy of Fine Arts, in New York, at the Beaux-Arts, Paris, and in Switzerland. While in Paris he attracted the attention of the noted American sculptor Paul W. Bartlett. After his return to Baltimore where he took over the foundry of the late Jacob Gminder, he cast all the figures for Bartlett's designs. The more notable of these include statues of Alexander Agassiz at Calumet, Mich., and at Harvard university, Cambridge, Mass.; heroic figure of Robert Morris in front of the Philadelphia custom house. He cast a large figure of Benjamin Franklin for Waterbury, Conn., and a reproduction of the great bronze statue of Chief Justice John Marshall which stands in the Capitol grounds, Washington. The reproduction now is located in front of the Philadelphia Memorial Hall Art Museum. Mr. Limerick was a member of the Sketch club, Philadelphia, and the Charcoal, Handicraft and Churchmen's clubs, Baltimore.

Robert I. Clegg, former associate editor of *Iron Trade Review* and THE FOUNDRY, and later editor of *Woodcraft*, all published in Cleveland, died Dec. 3 at his home in that city, aged 65 years. He was known widely in the technical publishing field, at the time of his death being vice president of the Gardner Printing Co., Cleveland, and the Masonic History Co., Chicago. Born in Lancashire, England, Mr. Clegg as a young man came to the United States to devote himself to writing on engineering. In the early 1900's he became associate editor and machinery editor for *Iron Trade Review*, then published at Cleveland by the Iron and Steel Press of which George H. Gardner was president. Clegg also contributed technical articles to THE FOUNDRY. About 1906 Messrs. Gardner and Clegg and others formed the Gardner Publishing Co. Later the monthly magazine *Woodcraft* was established by the Gardner company with Mr. Clegg as editor; but its publication was abandoned several years later. Mr. Clegg about 1907 became connected with *The Iron Age*. In 1916 and 1917 he served as vice president of the Cleveland board of education. He was a member of the American Society of Mechanical Engineers and of the American Society of Civil Engineers. One of his two surviving sons, Lee M. Clegg, is vice president of the Thompson Products Co., Cleveland.

Walter W. Cheney Jr., vice president, director and superintendent, S. Cheney & Son, Manlius, N. Y., died suddenly on Saturday, Nov. 28, due to pneumonia, at the age of 43. Mr. Cheney was a graduate of Lawrenceville school and Sheffield Scientific

Walter W. Cheney Jr.

School of Yale university, New Haven, Conn. He served on the border during the war and later was a lieutenant of artillery. For a number of years he has been associated with the National Founders' association, American Foundrymen's association, Central New York Foundrymen's association and also was secretary of the Syracuse & Eastern railroad.

Study Soil Corrosion

Research paper No. 329 published by the bureau of standards, Washington, gives data on the soil corrosion studies which were begun in 1922 and now are in progress. Materials used in the study are commercial ferrous pipe materials and include open-hearth iron, wrought iron, bessemer steel, and cast iron pipe. Results obtained so far do not indicate that any one material is superior to the others. Copies of the paper may be obtained from the superintendent of documents, Washington, for 10 cents.

The division of simplified practice of the bureau of standards has announced that the simplified practice recommendation R118-30, on abrasive grain sizes, has been reaffirmed by the standing committee of the industry, without change, for another year.

What Others Are Thinking

Abstracts Selected from European Foundry Literature

Heat Treats Cast Iron

The Heat Treating of Cast Iron (Les Traitement Thermiques des Fontes), by August Le Thomas, *La Fonderie Belge*, Liege, Belgium, September, 1931.

While considerable more investigation has been conducted on the heat treating of steel, the conclusions obtained for that material do not necessarily apply to cast iron. It is erroneous to consider cast iron as being a mixture of steel and graphite, as steel and cast iron have their own particular characteristics. The first subject discussed is the stabilization treatment to relieve internal stresses usually found in castings. Using a special test piece to determine the best method to remove the stresses, it was found that reheating the castings slowly up to about 650 degrees Cent. (1200 degrees Fahr.) and allowing them to cool slowly, practically eliminated the internal stresses but at the same time reduced the tensile strength somewhat.

The next subject treated is that known as the graphitization treatment which is done to obtain small graphite flakes, homogeneity, and a stable equilibrium of the iron. With irons rich in silicon and carbon, it is sufficient to heat them to between 300 and 400 degrees Cent. (572 and 752 degrees Fahr.). In the case of malleable iron, the treatment is more difficult due to the low silicon and carbon contents. Consequently, a temperature of about 850 degrees Cent. (1560 degrees Fahr.) is necessary to attain graphitization.

Impurities Affect Bronze

A Contribution to the Study of the Influence of Metallic and Nonmetallic Impurities in Bronze (Contribution a l'etude de l'influence des impuretes metalliques et non-metalliques dans les bronzes), by M. Ameline, *Bulletin* of the Association Technique de Fonderie, Paris, France, September, 1931.

In making an investigation on the effect of metallic and nonmetallic impurities or inclusions in bronzes over 550 bars were tested. Efforts were made to conduct the tests on a practical basis rather than on an exclusive laboratory scale. Ingots were taken from an 880-pound melt composed of 90 per cent electrolytic copper and 10 per cent pure tin. The selected ingots were remelted and recast to promote uniformity of composition. Definite amounts of foreign matter were added to the ingots to determine the effects of those materials on the final alloys which result.

It was found that the addition of lead up to 4 per cent does not materially impair the quality of the metal, but it does facilitate pouring. Addition of antimony only becomes detrimental from 1 per cent. A small percentage of antimony, less than 1 per cent, imparts to the alloy a special resistance to abrasion and corrosion and aids machining. Since arsenic rarely exceeds 0.5 per cent in bronzes, its influence is not detrimental. Zinc seems to have the least detrimental effect. In contrast to the previously mentioned effects, the addition of iron causes difficulties. Sulphur which forms a sulphide with copper, rapidly decreases the physical characteristics of the alloy. Oxygen added as copper oxide gave irregular effects. Tests on similar alloys made with secondary metals indicated that with the proper precautions to eliminate excessive impurities, good results are obtained and in the author's opinion such metal is satisfactory for castings.

Glasgow Trains Foundrymen

What Glasgow Is Doing to Train Foundrymen, by Dunlop Anderson and A. Campion at the inaugural meeting of the Scottish section of the Institute of British Foundrymen held in the Royal Technical College, Glasgow. *The Foundry Trade Journal*, London, Oct. 22, 1931.

The Scottish branch is responsible for the founding of the Sir Archibald McInnes Shaw prize and the educational committee of the corporation has arranged facilities in two schools for apprentices following the institute's course for the diploma in patternmaking and molding. Equipment is necessary to organize and improve trade classes. Industry as now organized does not permit giving apprentices the same facilities for learning the trade as were given 50 years ago. It is necessary to raise the standard of efficiency of the ordinary boy who is destined to remain a journeyman. The all around clever boy will push ahead by himself. Inclusion of a lot of physics, mathematics, etc., in a foundry course always has been considered necessary, but the value is doubtful. The scheme which the institute has initiated in conjunction with the city and Guilds of London institute represents a much needed departure from the ordinary course of foundry classes. In the past these courses had been arranged on highly technical or academic lines, in fact on university degree lines. Provision was made for about 5 per cent of foundry employes while the 95 per cent were neglected. The course consists of mathematics, physics, chemistry and more chemistry for three years. Those who survive get perhaps one evening a week in the fourth or fifth year of foundry lectures.

The idea of the new course is to retain interest throughout by starting immediately with descriptive foundry work and explaining the principles upon which certain operations are based and the reason for the use of certain materials for certain purposes.

Poor Yield Increases Costs

The Automatic Price Advance of Liquid Iron through Insufficient Yield (Die automatische Verteuerung des fluessigen Eisens bei nicht genuegendem Ausbringen), by W. Bremer, *Die Giesserei*, Duesseldorf, Germany, Nov. 6, 1931.

Yield is understood to be the relation of the weight of good castings to the charge weight. That relationship varies in different foundries, and may be taken as 65 per cent normally. Through unfavorable yield an appreciable price advance is caused for the liquid iron per 100 kilograms (220 pounds) of useful castings. That price advance is caused in the first place by the fact that the return scrap (wasters, gates, sprues, etc.) always is the same average price as the delivered prices of pig iron and purchased scrap, and therefore is considerably dearer than purchased scrap alone. The second cause is the resulting higher melting cost for 100 kilograms of good castings through insufficient yield.

To illustrate the price advance, a foundry with the average 65 per cent yield is taken. Two mixtures are used; one for cylinder iron and the other for machinery. In one month, however, the yield drops to 58 per cent, and the costs for each iron are increased per 100 kilograms (220 pounds) of good castings by about 12 and 9 cents, respectively, which amounts to $1.08 and $0.81 per ton of good castings. Other examples and data are given to show how poor yields produce losses.

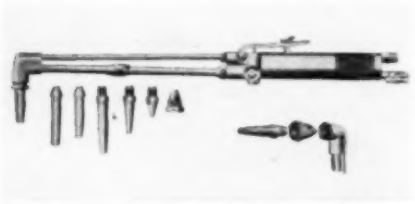
To Develop Efficiency

Personal Efficiency in the Foundry, from the presidential address of N. McManus at the inaugural meeting of the Scottish section of the Institute of British Foundrymen, in the Royal Technical college, Glasgow. *The Foundry Trade Journal*, London, Oct. 22, 1931.

A varied experience in many capacities has indicated clearly that large sums of money are lost through waste of time, energy and material, mainly due to want of a definite system. One hears much of efficiency, but if people would talk more about inefficiency it would serve a better purpose. Efficiency is nothing but the elimination of inefficiency. Suggested avenues of endeavor down which the subject might be pursued include: Adoption of modern methods and equipment, sanitary conditions, co-operation of men and management, a cost system that contains something more than a mere tabulation of figures, elimination of lost time by men and machines, sand preparation, practice in the cleaning and shipping department. Concerted effort should be concentrated on reduction of all waste.

Cutting Torch Employs Variety of Tips

Alexander Milburn Co., 1416-1428 West Baltimore street, Baltimore, has developed a new cutting and welding torch. One of these torches, together



A High Pressure Type Valve Features the Cutting Torch

with various tips which can be applied to it, is shown in the accompanying illustration.

This torch is designed to be rugged and durable, its principle parts being of bronze and its tubes of nickel silver. A feature of the design is a leak-proof, high pressure type valve, the seats of which are readily accessible for renewal without requiring disassembly of handl: or other parts.

As indicated in the illustration, the head will take conical seated tips which also fit another type of torch made by that company. Its tips also are interchangeable with torches of other makes. This new model can be converted immediately. from a cutting to a welding torch by a special adapter, which enables it to take several varieties of tips.

Gasoline Engine Drives Locomotive Crane

Silent Hoist Winch & Crane Co., 762 Henry street, Brooklyn, N. Y., recently introduced a new, gasoline powered, locomotive type crane designed for a variety of industrial uses. Dimensions of the equipment permit it to pass through openings as narrow as 5½ feet and as low as 7 feet. A short turning radius makes it possible to negotiate intersecting aisles usually found in industrial plants. The rated capacity of the crane is from 5000 pounds at a 5 foot radius to 2500 pounds at a 10 foot radius. The rated capacity loads may be swung safely through an arc of 180 degrees.

Traction wheels are in front and support the load hanging from the hook. Power for operating the crane mechanism is obtained from the engine through a roller chain drive from a two speed power take off attached to the transmission. The winches are so constructed that the power is applied to lower the load as well as to raise it. When the power is off the loaded booms are held securely in position by a self-locking characteristic of the worm gear plus an auxiliary shoe brake which is applied automatically. The boom swinging mechanism includes an enclosed worm gearing and built-in reversing clutch unit, the same as for the winches in size and design. A swing stopping device which prevents overswing also is provided and the boom is held locked in position automatically. A view of the new crane is shown in the accompanying illustration.

Deoxidizes Steel Bath

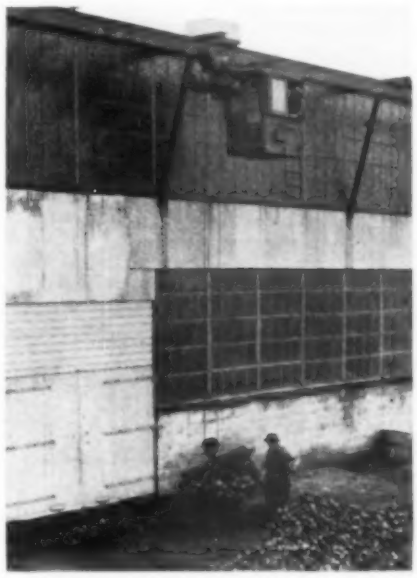
The Titanium Alloy Mfg. Co., Niagara Falls, N. Y., recently has published a 112-page booklet entitled "Ferro Carbon-Titanium in Steel Making." The publication gives the titanium alloys available for commercial use, and the action of the alloys in steel baths. It explains the use of titanium alloys in the manufacture of effervescing steel, forging steels, alloy steels, rail steel for castings, and gives some comparative tests on treated and untreated steels.

Monorail Hoist Solves Handling Problem

Materials handling problem confronted the Schwab Furnace Mfg. Co. when that organization built a new addition to its foundry at Cedar Grove, Wis. The problem was to adapt new equipment to conditions which already existed, but at the same time, increase the capacity of the old foundry layout by five or six times.

Previously, coke was unloaded from a railroad siding next to the old foundry and wheeled to an elevator, raised to the cupola floor, and transported to the cupola with barrows. The new foundry extended 100 feet beyond the end of the railroad siding, making the distance to the cupola too much to cover with wheel barrows. Lack of room made it impractical to increase the length of the side track.

As a solution, the company installed

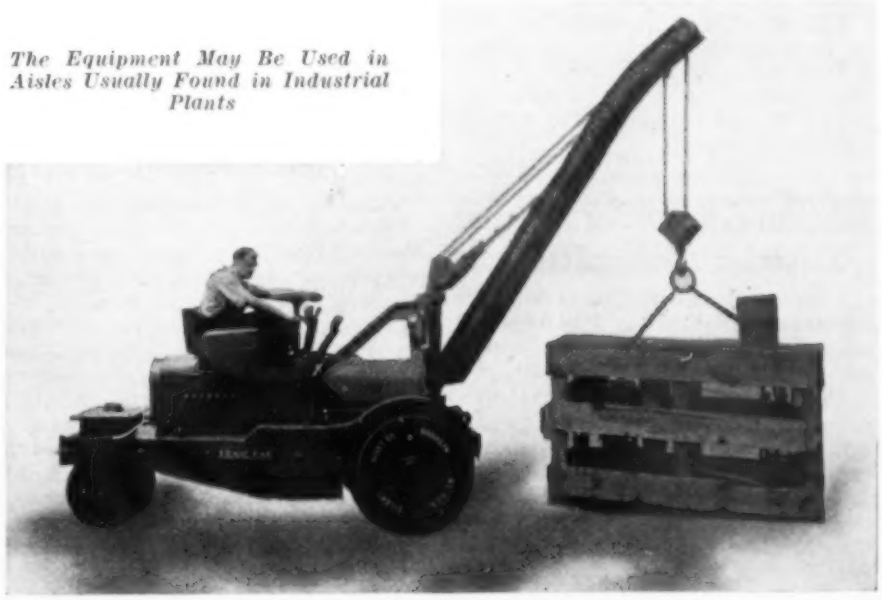


Coke Is Carried from the Sidetrack To the Cupola

an outside monorail along the outer wall of the new building as shown in the accompanying illustration. Along this rail a 3-ton motor-driven trolley hoist, made by the Milwaukee Electric Crane & Hoist division, Harnischfeger Corp., Milwaukee, and equipped with an operator's cage, transports coke and iron to a platform next to the cupola. The hoist has sufficient cable to permit the operator to lower the bucket to the ground.

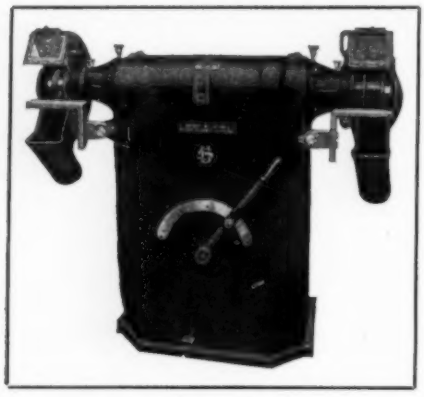
Although the new foundry has a capacity of 12 to 15 tons a day, compared to 2 or 3 tons a day in the old plant, the present set-up requires only about the same amount of labor for charging.

The Equipment May Be Used in Aisles Usually Found in Industrial Plants



Wheel Surface Speed Is Constant

The United States Electrical Tool Co., Cincinnati, recently has designed a smaller model of its variable speed grinder. A feature of the grinder, which is shown in accompanying illustration, is its ability to maintain a constant wheel surface speed regardless of wheel wear, using the wheels down to the flanges. This constant



Speed Changes Are Made Through a V-Disk Transmission

speed is accomplished by a V-disk transmission of graphitized micarta. As the wheel wears, the operator shifts easily and almost instantly into the next spindle speed by a hand lever and foot pedal shown on the front of the grinder in the illustration. The speed lever is interlocked with the wheel guards, making excessive speeds impossible.

The grinder is built for continuous, heavy service, and in accordance with the safety code of the American Engineering Standards committee. The grinder is equipped with ball bearings throughout in dust-proof housings, a chrome-manganese motor shaft and wheel spindle, adjustable cast steel wheel guards, and a push button control with no-voltage release.

The machine is supplied in sizes to accommodate wheels 2 x 12 inches, 3 x 14 inches, 2 x 18 inches and 2 x 20 inches, for 220, 440 or 550 volts, 25, 30, 40, 50 and 60 cycles, 2 or 3-phase alternating current.

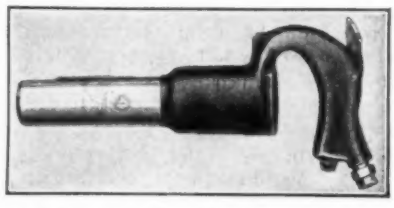
National Founders Name District Committees

District committees to serve during 1932, announced at the 35th annual meeting of the National Founders' association, are: First district—Frank R. Hoadley, Farrel-Birmingham Co. Inc., Ansonia, Conn.; Edward F. Parks, Universal Winding Co., Auburn, R. I.; second district—E. B. McKenna, Standard Foundry Co., Buffalo; Third district—William L. Litle, Bucyrus-Erie Co., Erie, Pa.; George T. Ladd, United Engineering & Foundry Co., Pittsburgh; Fourth district—William B. Cullen, Miami Foundry Co., Miamisburg, O.; Fifth district—A. H. Head, John Deere Tractor Co., Waterloo, Iowa; W. F. Heesch, French & Hecht Inc., Davenport, Iowa; F. Ackerman, Curtis Mfg. Co., St. Louis; Sixth district—Curry S. Prescott, Prescott & Co., Menominee, Wis.; John W. Brawley, South Park Foundry & Machine Co., St. Paul; Seventh district—W. F. Tynes, Hardie-Tynes Mfg. Co., Birmingham, Ala.; C. P. Caldwell, Caldwell Foundry & Machine Co., Birmingham; H. A. McLellan, General Fire Extinguisher Co., Atlanta, Ga.

Chipper Has Five Parts

Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, recently announced a new line of ring valve chipping hammers designed for such operations as chipping work on gray iron and steel castings, calking, scaling, flue-beading, trimming flush head rivets, etc. From 2000 to 3000 blows per minute are obtainable with these new units, one of which is shown in the accompanying illustration.

Five major parts comprise the new hammer. The valve is a sim-



A Device Automatically Locks the Handle

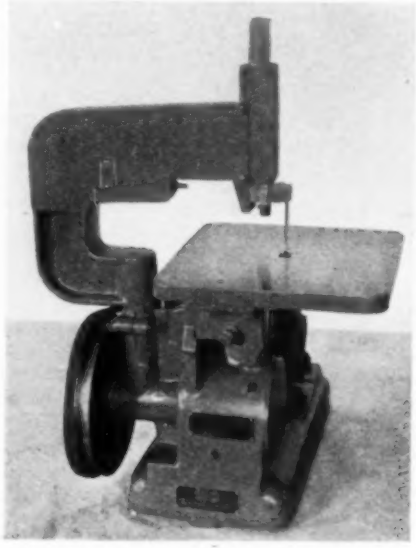
ple band ring placed over the end of the cylinder, having only 1/64 to 1/32-inch movement depending upon the size of the hammer. This construction permits the complete elimination of valve case and dowel pins. Another feature is the locking device which automatically lightens the handle.

Steel Output Up

The output of steel castings in the Philadelphia district during October was 12.4 per cent higher than during September, according to a recent report of the Industrial Research Department of the University of Pennsylvania, Philadelphia. Production of gray iron castings during October was 10 per cent less than during the previous month, although the decrease in shipments was not as severe as in production. The tonnage of malleable iron castings produced was 9.7 per cent higher than in September and 11.7 per cent more than during October, 1930.

Die Making Machine Is Redesigned

Oliver Instrument Co., Adrian, Mich., recently announced a redesigned die making machine incorporating features which is claimed to have added to its efficiency and ease



Filing and Sawing Are Accomplished By the Overarm

of operation. The unit shown in the accompanying illustration is a motor-belt driven model arranged for bench mounting. The table of the new machine is of heavy construction, rigidly supported on two brackets and tilts in four directions to facilitate various operations on the machine.

Filing and sawing are accomplished by the overarm, the upper end of the file or saw being clamped to a ram which reciprocates in bearings. The upper ram is of tool steel and is actuated through a bell crank lever and a heavy coil spring which provides a proper uniform tension on the saw. To remove the die for inspection, the overarm may be swung away from the file and brought back to the same position instantly when filing is ready to be resumed.

Holddown fingers are attached directly to the overarm and the working surface of the table is entirely clear. This machine is provided with a new type of chuck. It consists of a solid and a moveable hardened jaw, these jaws being brought together by a screw. The chuck on the lower ram and the one on the upper ram are accurately in line. The same chuck is used for holding saws, files and lapping sticks.

Truscon Steel Co., Youngstown, O., has acquired the Berger Mfg. Co. Building Products division at Canton, O., and will continue to operate it as the Berger Building Products Division of the Truscon Steel Co.

What the Foundries Are Doing

Reflecting the Activities of Gray Iron, Malleable, Steel and Brass Shops

Peerless Foundry Co., Cincinnati, suffered fire damage to the extent of approximately $20,000 on Nov. 21.

Arthur Foundry, Summit avenue and S. A. L. railroad, Charlotte, N. C., has changed its name to the Atlas Foundry.

Granite City Castings Co., Granite City, Ill., has been organized to manufacture ferrous and nonferrous castings for the jobbing trade.

Nassau Brass Foundry, formerly located at 190 Berry street, Brooklyn, N. Y., now is located at Freeman and West streets.

S. E. Stephenson has resigned as receiver for the Crown Pipe & Foundry Co., Columbus, O., and Dwight Jones has been appointed successor.

Terre Haute Malleable & Mfg. Co., Terre Haute, Ind., plans to install motors and other power equipment in its burned plant.

Campbell, Wyant & Cannon, Muskegon, Mich., has developed a new brake drum for passenger cars and trucks, which is being used by one large automobile manufacturer.

A. Gilbert & Sons Brass Foundry, 4015 Forest Park boulevard, St. Louis, recently filed a voluntary petition in bankruptcy. The company has been in business in St. Louis for over 50 years.

Kinloch Brass Casting Co., 2356 Palm street, St. Louis, is taking bids for a 1-story foundry, 59 x 70 feet, to cost $24,000. William F. McMahon, Buder building, is architect.

Atterbury Products Co., Pittsburgh, has been incorporated with 10,000 shares no par value to manufacture valves, fittings, castings, pipe and other products of ferrous and nonferrous metals, by Niles W. Atterbury, 124 South Highland avenue, Pittsburgh.

San Antonio Foundry Co., San Antonio, Tex., has moved its plant from 1425 South Alamo street to 500 Blue Star street. The new and considerably larger plant is situated between the Missouri-Kansas-Texas tracks and the San Antonio river.

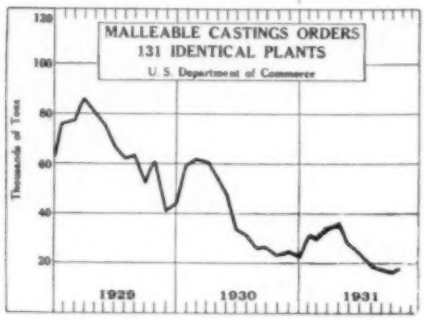
Charles L. Frederick, 46 North Foster street, Norwalk, O., is razing buildings at Page and North Foster streets for erection of three buildings, machine shop 36 x 66 feet, foundry and blacksmith shop 16 x 30 feet, warehouse 16 x 40 feet, equipped with two traveling cranes, one on 26 and one on 46-foot runway.

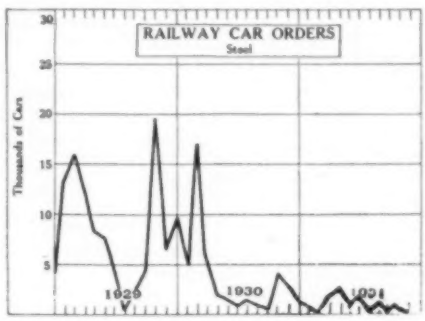
Jamestown Iron Works, Jamestown, N. Y., one of the oldest iron foundries in western New York, and operated under the management of Thomas Maher & Son, has completed the construction work on a modern one-story steel and concrete factory building. The new unit represents an expenditure of $50,000 for building and equipment.

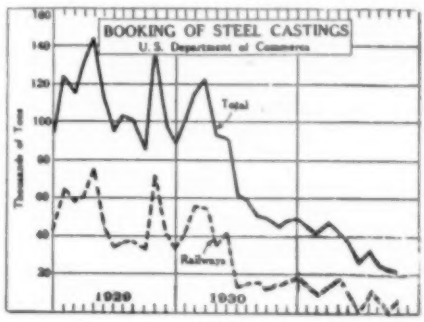
Chicago foundry operations, including western Michigan plants, were barely 28 per cent at the beginning of the month. Several brass foundry schedules that had increased during late November again dropped off. Several aluminum foundries were operating on schedules of four to five days a week, as demand from the aluminum cooking utensil industry has been on the increase.

J. Roy Tanner has been appointed receiver for the Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, on petition of the Taylor Forge & Pipe Co., Cicero, Ill. The petition states that the Pittsburgh company has assets of $2,000,000 and liabilities of $1,000,000, of which $974,500 is represented by a first mortgage 6 per cent bond issue. Mr. Tanner is president of the Pittsburgh company.

An increase of 7000 tons in the production of castings in 1932 by the Saginaw Malleable Iron division of General Motors recently was predicted by David O. Thomas, general manager. Mr. Thomas said that the Saginaw foundry production in 1930 was larger than in 1929 and that the total output in 1931 will be approximately 10,000 tons greater than in 1930. The Saginaw plant now is operating 6 days a week. It is expected that at least 53,000 tons of malleable castings will be made in 1932 compared with 46,500 tons in 1930 and 37,600 tons in 1929.







RAW MATERIAL PRICES

Dec. 9, 1931

Iron	
No. 2, foundry, Valley	$16.00
No. 2 Southern, Birmingham	12.00
No. 2 foundry, Chicago	17.00
No. 2 foundry, Buffalo	17.00
Basic, Valley	15.00
Basic, Buffalo	16.50 to 17.00
Malleable, Chicago	17.00
Malleable, Buffalo	17.50
Coke	
Connellsville Beehive coke	$3.25 to 4.50
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$9.25 to 9.75
Heavy melting steel, Pitts.	10.00 to 10.50
Heavy melting steel, Chicago	7.50 to 8.00
Stove plate, Buffalo	8.50 to 8.75
Stove plate, Chicago	7.00 to 7.50
No. 1 cast, New York	7.00 to 7.50
No. 1 cast, Chicago	8.00 to 8.50
No. 1 cast, Philadelphia	11.50
No. 1 cast, Pittsburgh	10.00 to 10.50
No. 1 cast, Birmingham	9.00 to 10.00
Car wheels, iron, Pittsburgh	10.00 to 10.50
Car wheels, iron, Chicago	9.00 to 9.50
Railroad malleable, Chicago	8.00 to 8.50
Agricultural mal., Chicago	7.50 to 8.00
Malleable, Buffalo	10.00 to 10.50
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	6.25 to 6.50
Straits tin	20.62½
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	8.50 to 9.50
Lead, New York	3.85
Antimony, New York	6.25
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	3.17½

Trade Publications

OIL BURNERS—Enterprise Oil Burner Co., 2902 Nineteenth street, San Francisco, has issued a catalog describing its complete line of oil burners. The publication includes illustrations and details of the burners, specifications and data on fuel consumption and vital heating statistics. Information on the various applications of the burners also is included.

ELECTRIC FURNACES — General Electric Co., Schenectady, N. Y., has issued a bulletin No. 1146-A describing and illustrating the various types of electric furnaces which it manufactures for industrial use. The material presented includes information on resistor units, annealing furnaces, hardening furnaces, conveyor type units, air draw furnaces, galvanizing tanks, and enameling furnaces. The company also has prepared a bulletin No. 1324-A describing in detail its air-draw furnace.

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Safety Grinding Wheel & Machine Co., Springfield, O.

ABRASIVES—Metallic

American Steel Abrasives Co., Galion, O.
Globe Steel Abrasive Co., Dept. F., Mansfield, O.
Patch-Wegner Co., Inc., Rutland, Vt.
Philadelphia Steel Abrasive Co., The, East of Lewis & Ashland Sts., Frankford, Philadelphia, Pa.
Pittsburgh Crushed Steel Co., Pittsburgh, Pa.
Steel Shot & Grit Co., Amesbury, Mass.
Steelblast Abrasives Co., 6536 Carnegie Ave., Cleveland, O.

ACETYLENE DISSOLVED OR IN CYLINDERS

Linde Air Products Co., 30 E. 42nd St., New York City.

ACETYLENE GENERATING APPARATUS

Linde Air Products Co., 30 E. 42nd St., New York City.

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General Electric Co., Schenectady, N. Y.

ALLOYS

Driver-Harris Co., Harrison, N. J.
Electro Metallurgical Sales Corp., 30 E. 42nd St., New York City.

ALUMINUM

British Aluminium Co., Ltd., 122 E. 42nd St., New York City.

ALUMINUM—Alloys and Ingots

British Aluminium Co., Ltd., 122 E. 42nd St., New York City.

ARC WELDING EQUIPMENT

General Electric Co., Schenectady, N. Y.

ARCHITECTS—Industrial

Austin Co., The, 16112 Euclid Ave., Cleveland, O.

ARRESTORS & COLLECTORS—Dust—See Dust Arresting and Collecting Systems

BABBITT METAL

Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

BARS (Steel)

Bethlehem Steel Co., Bethlehem, Pa.

BELLOWS—Molders

Osborn Mfg. Co., Inc., 5401 Hamilton Ave., Cleveland, O.

BLAST METERS

Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.

BLOWERS

General Electric Co., Schenectady, N. Y.
Spencer Turbine Co., Hartford, Conn.

BOLTS AND NUTS

Bethlehem Steel Co., Bethlehem, Pa.
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BOOKS—Technical

Penton Publishing Co., Cleveland.

BOTTOM PLATES—Steel

Truscon Steel Co. (Pressed Steel Div.) 6100 Truscon Ave., Cleveland, O.

BRONZE—Manganese

Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

BRUSHES—Foundry

Osborn Mfg. Co., Inc., 5401 Hamilton Ave., Cleveland, O.

BRUSHES—Motor and Generator

General Electric Co., Schenectady, N. Y.
United States Graphite Co., The, Saginaw, Mich.

BUCKETS

Penn Foundry & Mfg. Co., Reading, Pa.

BUCKETS—Clamshell, Dragline, Grab

Brosius, Edgar E., Inc., 19th St. & P. R. R., Sharpsburg P. O., Pittsburgh, Pa.

BUILDINGS—Foundry, Factory, Industrial

Austin Co., The, 16112 Euclid Ave., Cleveland, O.

BURNERS—Oil or Gas

Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.

BUSHINGS—Flask Pin

Michigan Screw Co., Lansing, Mich.

CALCIUM—SILICON

Electro Metallurgical Sales Corp., 30 E. 42nd St., New York City.

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Linde Air Products Co., 30 E. 42nd St., New York City.

CARBIDE

Linde Air Products Co., 30 E. 42nd St., New York City.

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Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Penn Foundry & Mfg. Co., Reading, Pa.

CARS & LOCOMOTIVES—Industrial

Industrial Equipment Co., The, Minster, O.

CASTINGS (Gray Iron)

Bethlehem Steel Co., Bethlehem, Pa.

CASTINGS (Heat Resistant)

Driver-Harris Co., Harrison, N. J.

CASTINGS (Nickel Chromium)

Driver-Harris Co., Harrison, N. J.

CEMENT—High Temperature, Refractory

Alpha-Lux Co., Inc., 192 Front St., New York City.

CHAINS (Crane & Slings)

Newhall Chain Forge & Iron Co., 9-15 Park Place, New York, N. Y.

CHARGING EQUIPMENT—Air Furnace

Euclid-Armington Corp., 1364 Chardon Rd., Euclid, Ohio.

CHROMIUM

Electro Metallurgical Sales Corp., 30 E. 42nd St., New York City.

COAL

Hanna Furnace Corp., The, Detroit, Mich.

COAL CRUSHERS and Pulverizers

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COKE

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Arcade Mfg. Co., Dept. D., Freeport, Ill.
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Cleveland Electric Tramrail Div. of Cleveland Crane & Eng. Co., Wickliffe, O.
National Engineering Co., 549 W. Washington Blvd., Chicago.
Osborn Mfg. Co., Inc., 5401 Hamilton Ave., Cleveland, O.

CORE BINDERS

Corn Products Refining Co., 17 Battery Place., New York City.
Smith, Werner G., Co., 2191 W. 110th St., Cleveland, O.

CORE BREAKERS

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CORE COMPOUNDS

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CORE MAKING MACHINES

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Demmler, Wm., & Bros., Kewanee, Ill.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.
International Molding Machine Co., 2616 W. 16th St., Chicago, Ill.
Osborn Mfg. Co., Inc., 5401 Hamilton Ave., Cleveland, O.
Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia, Pa.

CORE OIL

Smith, Werner G., Co., 2191 W. 110th St., Cleveland, O.

CORE OVENS—See Ovens—Core-Mold

CORE RACKS

Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
Truscon Steel Co. (Pressed Steel Div.) 6100 Truscon Ave., Cleveland, O.

CORE RODS

Franklin Core Rod & Gagger Co., Franklin, Pa.

CORE ROOM EQUIPMENT

Truscon Steel Co. (Pressed Steel Div.) 6100 Truscon Ave., Cleveland, O.

CORE SAND MIXERS

National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.